

Aviation Week

Including Space Technology

How Nose Cone
Is Formed for
Army Satellite

March 10, 1958 75 cents

A McGraw-Hill Publication



McDonnell F-101B Carries
Douglas MB-1 Genies

Fuselage Hoops Resist Fatigue Cracks



CONVAIR JET 880

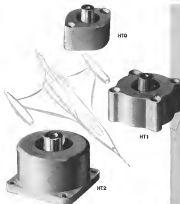
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Transmissibility curve for new LORD BTR Mountings exhibits no discontinuities. Here HT0 type, transmissibility is below 0 dB.



Isometric and radial redistribution curves show usability including shock absorption characteristics of BTR Mountings

new LORD BTR mountings for airborne electronic equipment

LORD introduces a new series of vibration control mountings for the protection of airborne electronic equipment. They incorporate LORD's new Liquid Temperature Range elastomer—"BTR"—which combines performance-proven elastomer advantages with extreme environmental resistance.

BTR Mountings provide excellent all-attitude vibration isolation of frequencies to 2000 c.p.s. under steady state conditions and transient shock conditions—with no standing waves, distributed system responses or "beating." Broad temperature operation is possible since transmissibility and resonant frequency remain virtually constant from -65° to 300° F.

The BTR elastomer combines three functions—load support, damping and snubbing. In rooms of air and ozone, has high tensile strength, high tear resistance and good fire life.

The new mountings are designed in three basic sizes—HT0, HT1 and HT2—for loads from 3 to 40 pounds per mounting. Specification MIL-C-173B mounting hole configurations provide maximum interchangeability in standard industry equipment.

For further details on the new BTR Mountings, consult your nearest LORD field engineer, or contact the Home Office, Erie, Pa.

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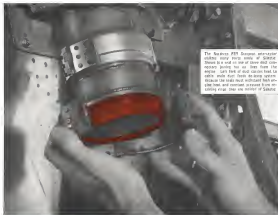
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- provide excellent all-attitude vibration control

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The Selside PRT Doppler interferometer makes many measurements of Selside. It is used on one of three dual component joints to see how they move. It can also be used to check the position of the engine. It can also be used to check the position of the engine. It can also be used to check the position of the engine.

SILASTIC

SILICONE RUBBER

For resistance to fuels oils and solvents, specify Silastic LS

keeps shape under heat, clamping

Temperatures of 500°F are easily withstood by parts molded of Silastic[®], the Dow Corning silicone rubber. At -120°F, Silastic remains strong and resilient. Compression set runs as low as 15% at 300°F; resistance to weathering, oxidation, and ozone is exceptionally high. Silastic molded parts are available in almost any size, shape, or color from many leading rubber fabricators.

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It is good to stay cool

AVIATION CALENDAR

Mar. 15-16-Institute of the Aeronautical Sciences, National Flight Propulsion Meeting (Short Sessions reported), Hotel Carter, Cleveland Ohio

Mar. 13-14-National Nuclear Conference on Aviation Education, Hotel Madison, Washington D.C.

Mar. 14-Versar Production Meeting, Society of Automotive Engineers, Louis Armory Hotel, Madison, Idaho, U.S.

Mar. 15-20-Joint Aviation Conference, American Rocket Society Institute, Society of Mechanical Engineers, Hotel Hilton, Hotel Drake, Inc.

Mar. 17-21-1973 Nuclear Congress, International Symposium Chicago 73 Congress includes Fourth Nuclear Engineering & Science Conference, Nuclear Energy Management Conference, Sixth Hot Laboratories Conference and others

Mar. 18-19-Conference on extremely high temperatures (over 30,000K) sponsored by USAF, Cambridge Research Center, U.S. Government, Hotel, Bedford Mass.

Mar. 18-19-4th Joint Aero-Space and Industry Symposium on Guided Vehicle Training Equipment (hosted by those with South America) Naval Ordnance Laboratory, White Oaks, Silver Springs, Md. For details enter Mr. J. C. Vack, Head of New Weapons & Systems Division, U.S. Naval Training, Davis Center Post, Washington, D.C.

Mar. 22-23-1973 Western Space Age Conference and Exhibit, Science Exposition Hall, Los Angeles, Calif. Robert H. Hays, president, at room 1000, Mar. 22. The Mosby Dallas

Mar. 24-25-National Meeting, New Bedford, Mass. Hotel, Washington, D.C.

Mar. 24-25-Institute of Radio Engineers National Convention, Waldorf Astoria (Continued on page 6)

AVIATION WEEK including Special Technology

March 13, 1973
Vol. 56, No. 10

Aviation Week 1973 is a special event in the history of the aerospace industry. It is the first time that the industry has been able to bring together all the major players in the industry in one place. The event is a testament to the industry's growth and success over the years.

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Compact lightweight, to 5000 psi, 1/2 inch bore, 1/2 inch stroke, 1/2 inch output without mechanical assistance

ROTARY SHOCK ABSORBERS

Proven record of 2 million miles and 100,000 cycles of service in multiple duty and load

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Proven design, dampers in use on 100,000 aircraft, 100,000 cycles of service, 100,000 miles of service, 100,000 cycles of service

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TRANS-SONICS

INC. N.Y.

SURFACE TEMPERATURE TRANSDUCERS

CEMENT-ON™, Type 1375




The temperature sensing element is embedded in a drilled hole across which an insulating seal is cast.

TYPE	TEMPERATURE RANGE
1375A	-400 to +1000
1375B	0 to +2000
1375C	+100 to +1200
1375D	+100 to +1200

Standard-SENTEC Type 1375 cement.

WELD-ON™, Type 1376



The temperature sensing element is embedded in a drilled metal surface, and is insulated by cast welding the cap to the measuring metal surface.

TYPE	TEMPERATURE RANGE
1376A	0 to +1000
1376B	+200 to +1200
1376C	0 to +1200

- RANGED From -400F to +1250F
- OUTPUT Up to 5 volts without amplification
- RESISTANCE CHANGE: 300 ohms over affected range
- ACCURACY OF CALIBRATION: $\pm 1\%$ of range interval
 $\pm 0.2\%$ for temperatures over 1000F
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Trans-Sonics Cement-On Type 1375 and Weld-On Type 1376 Surface Temperature Transducers are platinum resistance thermometers that can be installed on any surface, flat or curved, metallic or nonmetallic, for accurate temperature measurement. The positive cover of the sensing element is protected or sealed directly to the thermal surface to form an insulating seal which gives a transmitter reading that corresponds to the true case temperature.

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Trans-Sonics

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(Continued from page 5)

- Heald and New York Colonias, New York City.
- Apr. 8-10—Light International Symposium Electronic Engineering Society Bldg., 35 W. 35 St., New York City.
- Apr. 8-11—National Aeronautics Meeting, Society of Automotive Engineers, Inc., Hotel Commodore, New York, N. Y.
- Apr. 30-31—Aeronautical Training Society Annual Meeting, Mayflower Hotel, Washington D. C.
- Apr. 10-12—Institute of Radio Engineers Conference and Electronic Show St. Anthony Hotel and Marriott Auditorium, San Antonio, Tex.
- Apr. 16—Industry Testing Requirements of Contacts Used in Aircraft Electric Systems, A. T. Truitt, Electronic Equipment Mfg. Co., Engineers Club, Philadelphia.
- Apr. 16-18—1958 Annual National Forum, American Helicopter Society, Maymont Park Hotel, Washington, D. C.
- Apr. 17-18—Institute of Environmental Engineers Second Annual Technical Meeting, New Yorker Hotel, New York City.
- Apr. 22-24—1958 Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.
- Apr. 22-24—1958 Annual Convention in International Airline Navigation Control, Paradise Hotel, New York, N. Y.
- Apr. 25—Biomedical Annual Symposium Conference, sponsored by Air Force Office of Special Research and Institute of Aeronautical Sciences, Shirley Kemp Hotel, Denver, Colo.
- May 1-3—35th Annual Meeting, American Society of Tool Engineers, Philadelphia Convention Center, Philadelphia, Pa.
- May 6-7—Fourth National Flight Test Interconference, Washington Park Station Hotel, New York City.
- May 12-14—National Conference on Astronautics Electronics, sponsored by Institute of Radio Engineers, Baltimore Hotel, Baltimore, Md.
- May 14-16—Spring Meeting, Society for Environmental Engineers, Hotel Maytag, Cleveland, Ohio.
- May 14-22—17th Annual National Conference, American Society of Mechanical Engineers, Inc., Baltimore Convention Center, Baltimore, Md.
- June 2-4—1958 National Telecommunications Conference, Lord Baltimore Hotel, Baltimore, Md.
- June 9-10—Fourth International Automation Exposition and Congress, Coleman N. Y.
- June 24-26—1958 Meeting, Aviation Education and Manufacturers Assn., Mount Washington Hotel, Boston Woods, N. H.
- June 25-27—Air Transportation Conference, sponsored by American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y. For information: S. H. Haverly, Jr., 6150 E. 10th, Cleveland 1, Ohio.
- Sept. 8-7—1958 Fairborough Flying Display and Exhibition, Society of British Aircraft Constructors, Fairbairn, England.
- Sept. 6-16—International Aviation Show, Colorado, New York, N. Y.

For the eyes of
Argus, the all-seeing



radomes by McMillan... developed and delivered
to meet Canada's roll-out date (scheduled 2½ years before)

Named ARGUS after the "watchful guardian" of Greek mythology, Canada's GL-36 carries the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft for locating, tracking and "fixing" enemy submarines. It has a number of radar "eyes".

The radomes for these "eyes" were developed by McMillan Industrial Corporation.

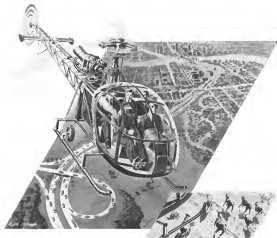
For the forward antenna, McMillan developed, manufactured and tested one of the largest radomes ever built—measuring 96' long x 8' wide x 8' deep. Tremendous in size, this radome had to be designed to be lightweight yet meet rigid electrical, environmental and structural requirements.

Whether your problem is that of a small, accurate missile radome, a somewhat similar radome or a ground radar system, you can benefit from McMillan's sixteen years of experience in design, manufacture and testing of all types of radomes.

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**Firestone Tires qualify as original
equipment on new Boeing 707 Jetliner**

Like most everything about the sleek, new Boeing 707, new kinds of tires were called for, new tire specs had to be written. To get the safest, most dependable tires that could be built Boeing accepted recommended qualification tests set up by the Tire and Rim Association. Tire engineers carefully reviewed the requirements and decided that dynamic testing at 200 m.p.h. was necessary to assure maximum safety. All tire manufacturers had to meet or exceed these specifications to qualify.

The first tires tested by Firestone passed with flying colors. That was not surprising because Firestone Tires had already been accepted as standard equipment on the new big long-range military jet bombers. In addition Firestone had years of experience in building all kinds of tires for the toughest kinds of service—tires to take the landing whallop of supersonic military jet fighters; the impact of heavy loads in rugged earth-moving operations; tires to withstand the best build-up in the fastest auto races in the world like the Indianapolis "500" and the Monaco International "500" where speeds average 150 m.p.h.

Firestone is proud to have been accepted as one of the companies supplying tires for the new Boeing Jetliner—proof of the part they have been assigned in ushering in this wonderful, new age of faster, safer, more comfortable air transportation.



Firestone

BETTER RUBBER FROM START TO FINISH
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Exclusively for Boeing at JAC Aircraft Corp. Boeing Building

B.F. Goodrich



How B. F. Goodrich aviation products help Flying Tigers give "Super" service

Backbone of the Flying Tiger Line's air freight operation both here and abroad is a fleet of 12 Lockheed Super HC-130 Hercules. To keep these big planes on schedule, and to help them give daily "Super" service, Flying Tiger depends on a wide variety of B. F. Goodrich aviation products.

B. F. Goodrich PNEUMATIC DELTAIR keeps wings on-line. Checkered rubber inlets and outlets automatically strip ice from wings under the most severe icing conditions.

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B. F. Goodrich Precision Sealing Systems in baggage doors and air buses, don't let air make servicing of equipment easier. They also ensure airtightness of doors applying conditioned air to the plane's service.

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B.F. Goodrich aviation products

Stagnation on Space?

Aerjet's five stage Moon rocket proposal to the Air Force, details of which are revealed on page 18, is another example of how the aviation industry has responded to the Soviet challenge as useful space exploration. Aerjet's proposal, like so many others now gathering Pentagon dust, is based on an ingenious combination of well-developed missile propulsion and guidance systems. But the real winning bid is getting the Aerjet and other aviation industry proposals off the ground and into space in the lack of top-level Pentagon decisions.

We are now well into the sixth month since the Soviet's Sputnik I shattered our technological superiority complex. With the exception of the scheduling of the Army's Jupiter C launched Explorer satellite program, literally nothing has been done to get a United States national space program under way. There has been a noticeable slackening off of Congressional interest in space since the specter of a major economic recession was raised last month.

Layer Upon Layer

In the Pentagon top level efforts have been devoted primarily to creation of a new layer of super-bureaucracy in the research and development picture and an inter-service struggle for the major space mission. Although the Army's failure with the second Explorer has knocked some of the gilt from the supersecretariat halo worn by the Redstone amendment, they are making a strong political move to turn Huntsville into the major space research center. This is despite the fact it is almost completely lacking in every type of facility required except good technical manpower.

There is also another strong political drive emanating from the advisory group organized by James Killian, the President's scientific aide, to initiate the Pentagon's Advanced Research Projects Agency into a super agency that will control all military research programs and provide a bright new course for some pioneering scientists whose bent has more toward political maneuvering than solid technical achievement. There is also an extremely dangerous trend on the part of some Air Force leaders to divert the service of all its research activities and test them to ACPA. What remaining les-

sed this nucleus is not clear at the moment except that there has always been a strong group within the Air Force that has never fully understood the real implications of a research program in terms of the service's future. They have bitterly resented the rise of the technically literate officer in the USAF hierarchy.

Development Over Research

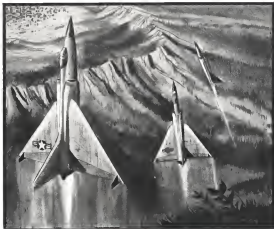
The research nucleus even in Air Research and Development Command, except for a brief period several years ago before the budget was decimated, has been a badly treated orphan in contrast to the emphasis on the development phase. We have detailed previously on this page USAF efforts to organize and operate an effective space research program and interrelations of these efforts by Donald Quisenberry and Charles E. Wilson. We can certainly understand the frustration of USAF leadership at having their steadily increased plans for space exploration vetoed two years ago and now being told that a brand new agency must be established to do the space job they find so hard to do earlier. Suddenly to abandon its research mission for political appeasement or for some role-and-mission home trading would certainly be useful for the Air Force or any other service.

Significant Struggle

The struggle now going on inside the White House, Pentagon and on Capitol Hill over how, by whom and when a national space program will be organized is one of the most significant of modern history. It will not only determine whether this nation will play a dominant role in the total exploration of space. It will also determine whether this nation can effectively organize a truly national program fully utilizing the scientific ability and the industrial capacity available to maintain a position of international leadership or whether we will continue to stumble along without positive direction, hamstrung by bureaucracy and stifled by technical timidity.

At the moment the outlines of how this policy is developing are still too dim for evaluation. Only one thing is certain. We are still waiting precious time.

—Robert Hots



HOW THE VERTIJET® CAN GIVE US A NEW SUPERIORITY IN THE AIR

The Ryan X-13 Vertijet®—which takes off and lands vertically on its jet thrust—has opened the way for a radically new kind of combat aircraft. A top air force expert says, "such vertical take off jets can give us a tactical advantage never before realized...as revolutionary as changes in tactics and strategy as the jet engine itself."

This advantage can be exploited not with these weapons: speed, maneuverability, mobility.

SPED—Combat Vertijets will fly faster than any plane now in the air. They'll climb vertically in high altitudes at supersonic speeds. This greater performance comes from the Vertijet's high power-to-

weight ratio. The dead weight of landing gear is replaced by the live weight of a more powerful engine. **MANEUVERABILITY**—The Vertijet's wings are designed for thrust only—not for take off and landing. Combat Vertijets will turn within one-fourth the radius of conventional fighters. And, they can stop and hover at any altitude—automatically return to high-speed flight.

MOBILITY—The Vertijet is not dependent upon vulnerable runways. It can be widely dispersed in land or on ships at sea. The Vertijet hangs by its nose hook from a single tow cable; its landing field is anywhere such a line can be rigged.

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WHO'S WHERE

In the Front Office

R. W. Bennett, chairman, and **R. K. Kunkin**, deputy chairman, Team Work Airlines, Jet Planning Committee. Mr. Bennett is USAF vice president-engineering and Mr. Kunkin is director of engineering research.

Lawrence Keller Schmitt, a vice president, Hughes Tool Co., Los Angeles, Calif.

Henry Lohm, vice president, Science Electronics Systems, division of Science Electronics Products, Inc., New York, N. Y.

David R. Hall, vice president-defense program, Harbison Manufacturing Co.

William G. Folles, a vice president of sales and executive board member, Norton Co., Worcester, Mass.

Dr. Barry G. Knapp, vice president-life sciences, Glaxochem Research, Inc., 5000 Spring, Md.; also, Robert Ruskoff, executive vice president, a director.

Dr. James Miller, vice president, RCA Laboratories, and **Joseph M. Herberg**, vice president, Defense Electronics Systems, Electronic Products, Radio Corporation of America, New York, N. Y.

Burtis Schellack, vice president sales, H. K. Porter Company, Inc., New York.

Henry W. Bidd, U. S. vice president, Isthmian Airline Services.

William M. Dunn, Jr., vice president—radio and radar, and **M. K. Williams**, vice president operations, ASA International Air Corp.

For T. Finkel, assistant vice president engineering, Regional & Western Airlines. **Jack B. Warshaw**, executive vice president and chief executive officer, Southern Commercial Co., Santa Monica, Calif. Also, **Robert E. Paul**, vice president-operations.

George B. Gelly, vice president marketing, Bellman Laboratories, Tucson, Arizona. **Electronics Corp.**, Los Angeles, Calif. **Alfred B. Wolter**, vice president services, Northeast Airlines Inc. Also, **Paul S. Dauterle**, Jr., assistant vice president-aircraft and operations.

W. C. Whitehead, president, Aerial Associates, division of Cleveland Pneumatic Industries, Inc., Cleveland, Ohio.

Honors and Elections

Curtis S. Flanders, Bureau of Aeronautics, has won a posthumous award for his service in the Navy's highest command. He was awarded the Distinguished Civilian Service Award for distinguished performance and for exceptional service.

T. E. Wigglesworth, retiring president of The United Aircraft Service Corp., will become the Gen. William K. Wright Award of the month named on April 1. The Award will be presented by Gen. Edwin W. Barlowe, Commanding General of the Air National Command.

Big Gen. Merrill C. Dwyer, AEDC Deputy Commander for Research and Development has been elected a Fellow of the Institute of the Aeronautical Sciences "for outstanding contribution to the field of aerodynamics."

(Continued on p. 55)

INDUSTRY OBSERVER

►Firing tests of the Douglas MB-1 Come stores an defense missile from Lockheed's F-104 Starfighter are scheduled to begin this month. Security reasons, without warheads, will be fired during the tests.

►Flight test program has begun on full-scale prototype of Pegasus Aircraft Corp.'s Sea Bat VTOL developed under Navy contract. Sea Bat is an unmanned remotely controlled attack wing theme designed for operation from offshore ships and submarines. Indications are that control is provided electronically to an autopilot.

►Simplified version of present pilot display will be adequate for X-15 class research vehicles. No need for additional frames of reference for pilot display as foreseen for the X-15 and its limited positions of space.

►Hughes Aircraft Co. is developing the fire control and cockpit displays for the testbed on North American's F-105 language interpreter.

►New device that would automatically warn a pilot with light or sound that he is falling asleep may be developed from a new skin resistance meter now being used by Wright Air Development Center's Aero Medical Laboratory to keep track of the activities of subjects undergoing prolonged isolation tests. Sleep warning might be particularly useful on long space flights. Heart of the system is a newly developed, electronic conductivity cloth that is laid against the sides of a man's head by his neck. Method is more comfortable than previous practice of inserting face wires subcutaneously to pick up the minute electrical currents required for the meter's operation.

►Foster Intercontinental range ballistic missile has been given a Strategic Missile command designation by USAF, which will use the Army-developed missile. Designation is SM-76.

►Boeing Helicopter Corp. has set a price of \$10,950 on its two-place all-terrain B-2 now in production at Bixler, Ohio. Price includes radio and cross navigation equipment. Current schedule calls for production of 17 B-2s, 12 for civilian use, the remainder for the Army. Initial deliveries of the military model are planned for next year.

►Air Force is having four separate versions of Republic Aviation Corp.'s F-405. F-405B is a single-seat day fighter-bomber. F-405D is a single-seat all-weather fighter-bomber. F-405E is a two-place all-weather fighter bomber. F-405F is being used as a test vehicle for infrared reconnaissance, detects a change from digital matrix of photographic reconnaissance to other reconnaissance methods.

►High vacuum electron gun is being used by Tennessee Metallurgical Corp., Richmond, Calif., to coat metals and other solid materials. Navy says that provides improvement over other devices by a factor of at least 10. Neutrons range 1.5 in. in diameter and 1 ft long are being drawn at a rate of 30 in., or 60 ft, per hour. Under Office of Naval Research contract, company is engineering use of the technique to test refractory metals such as molybdenum, tungsten and tantalum to prevent air-seal leakage.

►Full-scale test bed of Pegasus Aircraft Corp.'s ring wing VTOL, sponsored by Navy has completed ground tests, company is now conducting a wind tunnel investigation of a model. Basic configuration is that of a ring embodying an axial. Propulsion is by means of a ducted fan.

►Boeing Research intercepter missile fired on its back after vertical launch until the main engine engages on. Then the missile flips over into normal flight position.

►Lockheed is making prospective Expendable version of the F-104 that the supersonic fighter can carry five external stores under the wings and fuselage as a fighter-bomber. Current comparison being made with the Swift F-16 attack plane in roles where the F-104 can carry the same load with superior speed performance.



Dennis W. Holdsworth



Featured above is our new Research and Development Center now under construction in Woburn, Massachusetts (Included for comparison this post) the structure laboratory will house the scientific and technical staff of the new Research and Development Division.

AVCO's new research facilities now offers unusual and exciting career opportunities for exceptionally qualified and forward-thinking scientists and engineers.

Write to Dr. E. W. Johnson, Scientific and Technical Relations, AVCO Research and Development Division, 90 South Green Street, Lawrence, Massachusetts.

IDEALS AND PRACTICALITY

"Science and Philosophy mutually criticize each other and provide reciprocal material for each other."... Alfred North Whitehead.

In the increasing preoccupation of science with material things and progress, the truth of this statement by one of our greatest philosophers is often overlooked and forgotten. The scientific philosopher is a rare being and is becoming rarer still; nor can he be adequately replaced by the group technique or the "teamwork" notion.

It should be one of the subtlest aspirations of all our sciences to provide for the true contemplation of the true meaning of facts and to stimulate that interplay of mind on mind by which alone we may progress.

In all these things, however, we cannot forget the problems peculiar to research and development in private industry. The obligation to work to customer-determined time-scales poses a rare problem in balancing ideals against the practicalities of everyday life.

Even in this field that the best of management comes. Its success at meeting such continuously conflicting requirements determines the character and ultimate success of the organization.

With such thoughts as these in mind, we here at Research and Development Division of AVCO are seeking unique people. We seek to foster the creative minds and independent thinkers, while preserving an atmosphere of self-discipline, free from a rigid klansky of command and organization.

Dennis W. Holdsworth,
Manager, Research and Development Division

AVCO

Research & Advanced Development

Washington Roundup

Bridges Attacks ARPA

Sen Styles Bridges (R, N. H.) warned Defense Section No. 11 Mailbox last week that the Advanced Research Projects Agency should stick to policy and not become an operating agency. He said Congress had established the single-man agency for space and satellites as a policy-making agency and not to produce hardware for the military services.

Meanwhile, ARPA Director Roy W. Johnson named Rear Adm. John E. Clark, director of the Navy's guided missile division, as his deputy director. Adm. Clark will leave his Navy post. Johnson also appointed Laurence P. Case, former assistant director, Military Applications, Atomic Energy Commission, as director of program control and administration, and Lambert L. Lind of Illinois Services, N. Y., as special assistant director.

And, as the House, Rep. Peter Pickens (R, N. J.) introduced a bill to give the National Aeronautics Commission for Aeronautics control of all other projects for both civilian and military applications. The bill would increase the scope of NACA's authority and add instructions to the agency's charter.

Transportation Tax Repeal?

The economic decline has brightened the outlook for repeal of transportation taxes of 15% on freight and 30% on passengers. Members of Senate Commerce Committee are now pushing for repeal. Sen. George Eastman (D, Pa.), a member of the commerce committee and the leading Senate finance committee, makes these points:

- Small businesses would particularly benefit because they cannot easily provide their own transportation.
- Net revenue loss would not exceed \$125 million because much of the tax is on deductible business expense.
- Stimulating business repeal would result in a net outlay of \$100 million.

Yield vs. Fare Increase

A Northeast Airlines vote to hike air passage fares even higher than the rate reached as a result of the 4th 5% fare increase authorized last month has been postponed for its campaign in the Civil Aeronautics Board on grounds that the current fare is already the highest in the domestic industry. Northeast proposed to increase first class passenger fares because a number of points in \$1.00 would be added if added a cent to each ticket out in 1952 when the board permitted all domestic fares to make such an adjustment. The board, however, took a dim view of the proposal and noted that the board could bring the fare from one segment of the airline to as high as 11.5 cents per passenger mile. The board had Northeast's present average yield of 7.75 cents per passenger mile as "fair" for the highest of any trunk carrier.

Soviet Atom Plane Victory?

An Force Secretary James H. Douglas says the Soviets may well fly a nuclear-powered aircraft ahead of the U. S. because of a Defense Department decision four years ago

not to do so. As atomic plans at the cabinet date. In 1948, Defense decided to concentrate on nuclear and missiles until a useful weapon system was obtained.

Douglas added in testimony before the House Appropriations Committee that if the Russians had the ability of being able to say, "We can fly a nuclear-powered airplane, this may be a lot closer to it than the U. S. He said, however, that "recognition" within the U. S. project has been recommended.

Douglas told the committee that from 1946 through 1949 the total cost of the program for the Air Force, Navy and Atomic Energy Commission has been \$592,000,000. He said the General Electric Co. reactor and engine will be ready to test within the next three years but unless a "break" plan is adopted, the first flight may still be six or seven years away.

Space and Recession

Steele of engineers to make defense progress—particularly space and missiles—that passed in Congress at the opening of the session in January has shown some decline. Recession and the domestic economy are slowing political speeches.

House didn't get around to appointing its Special Committee on Aeronautics and Space Engineering until last week. The committee is a counterpart of the Senate special committee headed by Sen. Leonard Johnson (D, Tex.), Senate majority leader, and has been given until Jan. 15 to report its findings.

Rep. John McCann (D, Mass.) wants anyone, leader, in chairman, and Rep. Joseph Martin (R, Mass.), minority leader, is leading Republicans. Other members of the group are:

- Democrats: Rep. Charles Brooks (La.), Brooks Hays (Ark.), Lee O'Brien (N. Y.), Lee Mitchell (Mont.) 70%
- Republicans: L. B. Smith (S. D.), Gordon McDonough (Calif.), John V. Felt (Pa.), Kenneth Keating (N. Y.), Gerald Ford (Mich.).

Durfee Warning

Gov. Annenkov Board Chairman James R. Durfee has served notice on Congress that expanded local airline service is their respective areas grant leadership with additional appropriations to support that service. During the hearing in the Senate, Sen. Annenkov said a pointed letter in his address. Congress Durfee said that no congressional had appeared before the Board to suggest a discontinuance of removing or local airline service for the sake of economy. Rather, he said, every senator and representative who testified against, pleaded for an expansion of service. He suggested that the amount of additional service in the case recommended by the committee would result in a subsidy of about \$25 million and named that the field of local service operations will continually require a heavier subsidy burden if service is restricted. Durfee also said appropriate time to make his point. The Senate Annenkov Case was notable because of the unusually large number of members of Congress and representatives of state aeronautical agencies who appeared before the Board to ask for more service for their constituents.

—Washington staff

Aerogel Designs 5-Stage Moon Vehicle

Solid Senior rockets developed for Polaris, infrared homing guidance are features of proposal to USAF.

Washington—Aerobics M. Aerojet General Corp's Moon rocket proposal to the Air Force, is a five stage solid propellant vehicle, making use of Aerojet Senior rockets developed for Navy's Polaris and a triple terminal guidance system with an infrared sensor.

The proposal was submitted to Aerobics in a speech by Aerojet President Don A. Kunkin to the New York Society of Security Analysts. He said only that the company believed it could put the rocket on orbit around the Moon in a reasonable time frame. New York Times later learned details of the proposal.

Simple Launcher

Propaganda would be fired from a typical target ground launcher in a ballistics trajectory of a calculated time to cause that it will reach the ground near the Moon's orbit at a point when the Moon would be in its predicted position at that time.

Terminal guidance would be in the form of an infrared sensor on the rocketing two final solid-propellant rock-

ets—the first a subcarrier has destination the second a directional infrared rocket—would coincide with the near point of retro-mission and homing.

When the rocketing propellant reaches the ground plane of the Moon's orbit, the sensor "sees" the Moon, ignites the subcarrier to send the package's speed in its radial path from Earth's surface rocket, according to the paper's logic, is fired to divert the package in its path on Moon or to achieve lunar orbit. The rocketing vehicle is the Moon, depending upon its mission projected. Only around the Moon would launch data on the carrier for its, negative field, Moon topography, and accurate distribution, size and speed in the vicinity of Moon.

Sensors and associated components which cause operation of the solid and directional rockets might weigh about 10 lb.

Each of the guidance, the payload of instruments and transmitter (payload) would weigh about 25 to 35 lb.

There is ample heat for infrared de-

tection when the Moon is getting direct rays of Sun. This is true also when the Moon is in shadow, the vehicle's cold background of space.

No retrail guidance system is used to put the package into ballistic trajectory. To fire the vehicle in this manner trajectory, to intercept the Moon will be a difficult thing to do, but it is theoretically possible.

The Aerobics M proposal countermeasures various speed conditions to achieve various orbits around the Moon. This would require a series of counting the directional rocket to proper angle and going at desired thrust.

Seen required to the vehicle in ground launch, plan the vehicle's acceleration stabilization, is considered sufficient control to get it at a spot relative to the Moon where the terminal guidance can take over to ensure impact on satellite orbit around the Moon.

Solid Rockets

All solid rockets for Aerobics M would be Aerogel solid-propellant rockets. Including the full two rockets associated with terminal guidance, the package is a five stage configuration.

First stage is a cluster of four Aerojet Seniors, developed for Polaris in intermediate stage ballistics stage. The payload for this stage is polycarbonate fuel container, with a specific impulse which may be as high as 210. It is probable that this fuel would be used in all the rocket stages of the Moon vehicle.

During first stage burning, two rockets would support rotation for stabilization.

Second stage is a single Aerojet Senior.

Third stage is a single Aerojet Junior, which has been brought along during development of the Senior rocket motor.

Fourth stage is a cluster of four Aerojet rockets similar in thrust and direction to the Vanguard third stage (General Electric Rocket 3 unit).

Fifth stage is a single rocket of this type.

Proposal, made early in January, anticipates that cost of project would be about \$10 million. This would include development program for entire mission and guidance, state and flight tests of individual rocket stages, checkout of burning time and separation techniques.

Under present planning, Aerobics M might be ready for final, operational

flight within one year, sources of project support also give the program.

Although Kunkin, in his New York talk, referred to the Aerobics-M rocket as capable of putting a small man into space, no manned applications are envisioned in the Aerobics M report.

Data given in the Moon shot would be transmitted back to Earth by telemetry.

USAF itself has proposed a Moon shot using a Thor intermediate range ballistic missile with a solid propellant second stage drawn from Vanguard project components (AV March 1, p. 514).

A solid propellant second stage could be added to Thor vehicles, Air Force Secretary James H. Douglas said in testimony before the Senate, Air Force Committee last week. The second-stage package would be used in conjunction with USAF's recent study on satellite power.

He and a solid propellant second stage that would be available within that time would be a relatively small rocket stage of 5,000 to 10,000 lb thrust.

ARDC Centralizes Nuclear Developments

Washington—Central administration control and a single funding source to speed Air Force nuclear research and development program will be put into a new office within the Air Research and Development Command. That office has been designated the Office of the Assistant for Nuclear Program, will be headed by Col John H. de Ruyter.

The office separates the ARDC's Directorate of Nuclear Systems at Wright Field which was combined with the US 123A nuclear aircraft program.

Now, all of research, analysis, and development programs will be put under Col de Ruyter's management. His office will serve as a central control for all research and development in the field of ARDC nuclear program.

While Col de Ruyter's office will coordinate the development program, the working level control with ARDC, the field work of a nuclear project in other areas unchanged.

General Department of Defense, the Atomic Energy Commission and the Air Force all have control over the conception and built. The Atomic Energy Commission and the Air Force then must coordinate and coordinate the project's development and in effect, build, weapon, system, with defense secretary to power. The AEC has the nuclear development and the Air Force controls the design and construction of the vehicle.

Only one of a future frequency

Army Launches Explorer II; Orbit May Have Been Missed

By Even Clark

Cape Canaveral, Fla.—Army's Explorer II satellite apparently failed to enter orbit last week, after what appeared to be a successful launch from Air Force's Mobile Test Center.

Although some officials still held hope late last week, that the 30-in. 12-1/2 lb Explorer II might have entered orbit, Dr. William H. Pridgen, director of California Institute of Technology's Jet Propulsion Laboratory, said there is no indication that the satellite did not function normally and that it is not probable that it did not enter orbit. Pridgen and Army's Ballistic Missile Agency are joint developers of the project.

Pridgen's investigation showed probable cause of the failure was the failure of the first stage of the first stage rocket to fire.

Dr. Pridgen and Dr. Albert R. Hanks, chief of JPL's research and development section, said the preliminary evidence is that the first stage did not produce any thrust. That means it did not get up to velocity.

However, the first loss in a test shot did happen to the satellite after it was detected by at least one tracking station. The loss was not a total failure, but a reduction of the information available. Dr. Pridgen said it would require an additional day at least to complete evaluation of the data.

Other officials said the satellite re-looked in a new position slightly away from the position position needed to obtain a successful orbit.

Previous difficulties between the communication of the satellite Explorer II (AV Feb. 10 p. 12) and Explorer II was a small size satellite designed to measure its experience with cosmic rays. The recorder then would transmit the information as it passed over a tracking station.

The cosmic ray measurement package which could fly back on an second reconnaissance gathered in one orbit, was the most one supported by Dr. James van Allen of Iowa University the Navy Vanguard program in which cosmic ray readings from a Gage-Mueller tube are stored on the tape.

Low power transmitter was 10 watts with, about a 100 ft range. High power transmitter was 100 watts at 100 ft range.

Cosmic ray readings would be in terms of neutron in a function of time.

Only one of a future frequency

in orbit would generate Explorer II's data and pass into the country. After 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340, 342, 344, 346, 348, 350, 352, 354, 356, 358, 360, 362, 364, 366, 368, 370, 372, 374, 376, 378, 380, 382, 384, 386, 388, 390, 392, 394, 396, 398, 400, 402, 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 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Industry Faces Government-Facility Tax

Washington—Favorable for land-owning, higher rental fees for government-owned facilities as increased defense budgets to meet the new arms race result from a latest Supreme Court tax decision handed down last week.

Specifically, the new ruling—which in some aspects reverses 136 years of legal precedent—dictates:

- All government-owned plots leased or sold by private contractors are subject to this as local real property taxes at full value.
- All government-owned materials—aircraft, parts, durable and non-durable tools and equipment, such as process, etc.—held by government contractors are subject to state or local real property taxes.

Who Pays

In both cases, the lower level is payable by the contractor but, since there are allowable costs under defense contracts, the federal government will be forced to carry most of the burden.

One Defense Department official said that, if state and local tax officials make the expected move to take advantage of the ruling, it will cost the Defense Department hundreds of millions of dollars annually. It can exact these new costs, he said, only by asking Congress for more money or by cutting back on future orders.

The Defense Department also might shift the blow, he said, by raising the rentals on government-owned facilities.

As an indication of possible costs involved, 32 major aircraft companies have facilities for aircraft and related production spread at a combined total of \$1,315 million, without depreciation. Of this, the companies own approximately one-third, the government two-thirds.

The privately-owned facilities at these companies and others have been subject to local taxation.

Another indication is the still disputed levy by Los Angeles County, Calif., on government-owned aircraft, work in process and production equipment (AW July 5, p. 28). Last week, the city brought the county against nearly \$22 million from defense contractors.

Although the Los Angeles tax was not specifically involved in last week's decision, the ruling virtually ends Defense Department hopes of leaving it as standstill.

The case now is being appealed by Los Angeles County to the California Supreme Court following a lower court decision that each town is illegal.

Three Test Cases

The three test cases that led to the Supreme Court decision all involved Michigan facilities.

- **Manay Corp.** protesting with the federal government, leased property from leased by the City of Detroit and Wayne County, Mich. The city and county applied the tax to all plots,

materials and work in process assigned or sold by Manay in working on sub-contracts for aircraft parts.

Manay and the federal government protested that the tax violated government immunity from state taxation. The Supreme Court, however, denied the plea by a close four-to-three decision.

• **Bag-Warner Corp.** and **Continental Motors Corp.** producing local items on federal and military. Under a 1953 state law, a private party is subject to taxation to the same extent as though he owned the property if actually tax exempt plot property is used in a business conducted for profit.

Detroit Applies Law

City of Detroit applied the law to Bag-Warner which had leased a gas car rental-owned plant in Detroit. The new move was conducting no defense work at the facility.

The township of Madison, Mich., made use of all the same law to tax a Continental Motors Corp. plant where several government supply contracts were being filled.

Both Bag-Warner and Continental Motors contended in their test cases that the tax violated the immunity of federal property from state taxation. The court denied their petitions by a six-to-four vote.

In the case of strong government-owned equipment, the immunity rules in a precedent-breaking decision that the tax was applied as a "levy on a private

plant, possessing government property which it was using or possessing in the name of its business." As such, it ruled, the law is applied to all private property throughout the state of Michigan, is not discriminatory against private holding federal property and is not unconstitutional.

In arguing the Bag-Warner and Continental Motors plea the court ruled that the tax was imposed on a party using tax exempt property for its own beneficial use and advantage and, therefore, legal.

Senate Group Votes NACA \$10.5 Million

Washington—Senate Appropriations Committee last week voted \$10.5 million additional funds for National Aeronautics Commission for 1958 for the remainder of the 1958 fiscal year—\$1 million more than the House and House, but still below NACA's request for \$11.5 million.

The Committee took these actions:

- **Eliminated a House provision** which authorized the use of additional request funds for personnel salaries and added \$226,000 to cover salary increases all state granted. Under the House action, NACA would have to reduce personnel to basic funds to meet the increases.

• **Agreed with the House** on releasing funds for 465 new positions. NACA asked for \$910,000 additional to its current personnel from 7,935 to 8,400, a step toward the \$1,000 level provided in the fiscal 1959 authorization.

• **Approved NACA's request** for \$50 million for construction and equipment in full. The House allowed only \$8.7 million, demanding funds for office space. The money is for a new building to coordinate data processing facilities at the Langley Laboratory, Va., an ultra-high-temperature materials facility, also at Langley, to conduct the aerodynamic conditions encountered during the all-roughness entry of a long-range ballistic missile, and for modernization of a McDonnell 2-101 fighter to permit flight studies on various defense missions and in high performance aircraft and missiles.

The Senate Committee also voted additional funds for:

- **National Science Foundation**, \$5.9 million, the full amount requested, to continue activities in supporting a group of studies of basic research projects that have been selected for providing the translations of foreign language literature in the basic sciences and by expanding science education House approved \$8.7 million.

• **International Geophysics Year**, \$2 million, the amount approved by the House, to provide for radio and optical tracking of Russian satellites.

J. V. Naish Named Convair President

San Diego, Calif.—J. V. Naish has named Gen. Joseph T. McNamara (USA Ret.) as president of Convair Division of General Dynamics Corp. on April 3. Elevation of Naish, former executive vice president of Convair, was announced in Aviation Week on Dec. 9 (page 21).

Gen. McNamara, 64, who came to Convair as president and senior vice president of General Dynamics,



J. V. NAISH

will continue to serve as a consultant and as a member of the board of directors. He had served as Convair president since 1952.

Naish, also named a senior vice president of General Dynamics, joined Consolidated Vultee Aircraft Corp. in 1949 as the head of corporate director of contracts and San Diego Division manager of contracts.

In 1952, he became executive vice president and retained the position when Convair was merged into General Dynamics on April 30, 1954.

Bright Future Cited For Manned Aircraft

Washington—Air Force Secretary James H. Douglas says approximately 90% of USAF procurement funds will be spent on manned aircraft "for some years to come."

Douglas' appraisal of the future role for manned aircraft was rendered at the Jet Age Conference of the Air Force Association, held by Air Force Chief Secretary Dr. George H. Viles, Jr., and Maj. Gen. James F. Spenser, USAF director of requirements, deputy chief of staff, development.

Gen. Fugate said the conference that "With all of their capabilities, the destructive power of the missile is not equal to that of the manned bomber."

The power is increased both in terms of accuracy and weapon carrying capability. Ideally, missiles would prove more suitable against large industrial complexes.

"This alone, however, is not sufficient to deliver an enemy out of it as an alternative with Air Force leaders. A balance of missiles and aircraft of varying performance is needed to produce the greatest threat to an aggressor and the one most difficult to defend against."

Gen. Fugate and Air Force program include "massed defense of national range operating on nuclear power at low to high level. Conclusions of their characteristics could make them relatively insensitive to destruction, and they would be able to stay on station throughout the world, ready for instant attack."

Massed interceptor for defense also will continue to be "emphasized," Gen. Fugate said, to study to identify and destroy attacking vehicles "in far from has target as possible."

The North American F-105, he said, will be equipped with long-range missiles, air-to-air missiles, and air-to-ground missiles and have "the tactical mobility essential to fight tomorrow's air battle."

Dr. Viles warned that "because modern air war and venerable tools of technology" too many people feel "that this most automatically be superior weapon and will, therefore, automatically be adapted."

He added, "It is too simple a view, modern air war is complex, but they are additional to us armament their purposes are complementary to those of the manned airplane."

He said a great outside to rely, or to state or even to imply that there is some kind of competition between unmanned aircraft or missiles and manned aircraft. Missiles is the beginning will augment our manned forces, they will not replace them. They are thoroughly tested, and we are sure of their reliability."

In summation, Dr. Viles said he had "tried to show that the strategy of missile warfare is not possible because we cannot guarantee the accuracy and that, therefore, we should not place reliance upon missiles alone."

FBI Rocket Funds Cut

Government has withdrawn funds from program underway at Reaction Motors, Inc., to develop solid rocket for Chance Vought F4U Crusader. The government is still interested in subject of night fighter competition for the jet-powered fighter but the new law is to what degree the government will back this interest with money.



First Photo of Doak X-16 Ducted VTOL

Structural details are visible on improved Doak X-16 VTOL, which entirely new tailfin fitted. Wingtip-mounted ducted fans on perimeter drives are used to retract lift and landing, rotate 90 deg for high-speed forward flight.

Thor, Jupiter Use Vernier Engines For Precise Trajectory Control

By Michael Yaffe

New York—An Force *Endeavor* test took, that both the Thor and Jupiter will employ vernier engines in two different ways to obtain precise trajectory control.

Thor has two vernier engines. They are 180 deg. apart, one on each side of the sustainer nozzle. The vernier engines are started before the sustainer and continue to function after the sustainer is cut off. They can be activated, as required in test or full the missile into the prescribed trajectory. They have their own propellant.

Unlike the Thor, the Jupiter has no vernier engines in its first stage. Instead, it is mounted on a rotatable launch pad which swings the missile to the prescribed azimuth before firing. Once the Jupiter is fired, a single hydrostatic nozzle near the base of the missile, which can be swiveled as required, provides limited roll control.

Approximately 90 sec after the Jupiter turns off its launch pad, the nose cone separates. At this point, the sustainer has brought the vehicle roughly to the speed required for the parabolic ballistic trajectory. A single vernier engine in the base of the nose cone then adjusts the vehicle at the nose to within one foot/second of the exact speed. The vernier engine is fueled from its own solid propellant supply and can fire up to 45 sec. Once the nose cone is at the proper speed, the bottom section—containing the vernier engine and the guidance—is separated and the vehicle continues to target.

Additional details on the operation of both missiles were given by Col. William C. Edwards and Col. Henry J. Zink. Both officers are with the USAF Strategic Air Command. Col. Edwards will command the first Jupiter ICBM squadron now being trained at Barksdale, Ala., and Col. Zink is in charge of the first Thor ICBM squadron, is training at Creech Field, Calif.

Each squadron will have 15 missiles. In operation, the Jupiter squadron will have six missiles vertically positioned on launchers, in a ready state of 15 minutes, and capable of being fired in a multiwave mode. Six more Jupiters will be ready and ready for launch as soon as the first six are fired. The accuracy, these missiles will be in the maximum range in single-stage operation where they are not readily available.

All 15 Thors will be ready at the T-15 minutes countdown and capable of being fired simultaneously. Unlike

the Jupiter, they will be in a horizontal position so that transportation over long short ranges. On an alert, the Thor will be rolled over, the missile will be hydraulically raised on its transporter to a vertical position. The transporter will be lowered, and the missile will be left upright alongside a single-rocketing pad.

Propellant loading of the Thor will begin as the missile is being erected. Under pressure of gaseous oxygen, fuel will be fed from a storage tank into the top of the missile, and the oxidizer will be fed under pressure of gaseous oxygen, from another storage tank into the bottom of the missile. Meanwhile all channels will be made and after the propellant tanks are loaded, they will be topped off. At T-12 minutes, the topping and check-out are stopped. The vernier engines are started and, at zero minutes, the transporter is fired.

Lighting operations is less automated than that of the Thor, and requires about 5% more people (there will be 500 to 600 persons in the Thor squadrons). The time difference is negligible, says Col. Edwards. The Jupiters are erected by using cranes and hoists. To be ready in a T-15 condition, they must be brought on their firing pads, and to have no hangups. The pre-conditions are pumped from tanks in shed of storage tanks and base area sections are made to load.

Those of the Rocketeers engine used in the Thor and Jupiter was given

Project Minuteman

Washington—The Force is developing a three-propellant, solid propellant ballistic missile weapon system that can be used in a tactical weapon or fixed over other missiles and intercontinental range.

Designated Minuteman, the weapon system is scheduled to become operational in 1963 and will be fired from underground launching sites. Third stage of Minuteman could be used as a tactical ballistic missile over 300-1,500 mi. range. Second and third stages could be combined to form a 1,500-mile intercontinental range ballistic missile for deployment overseas. All three stages could be deployed as an intercontinental ballistic missile.

In meeting Defense Department approval to go ahead with the project, Air Force was told to consider use of Navy's solid-propellant Polaris ICBM as an interim weapon and to accelerate development with an liquid propellant

in 150,000 lb by both Col. Zink and Col. Edwards. The engine operates on liquid oxygen and RP-1 (RP-1 is a light cut kerosene, distilled off between 280F and 525F, and has few contaminating aromatics). JP-4, on the other hand, is a wide cut kerosene, taken off between 200F and 540F, and contains most of the lower energy aromatics.

With minor changes in valves and the like, the engine could use the new, higher energy, hydrogen-based fuel developed by Rocketdyne for the Starliner first stage of the Explorer. But it is doubtful that the performance gain would warrant it. It would be preferable to design a motor around the new test, Col. Edwards said.

On Feb. 25, the Air Force fired its two model 125 in the Thor across Model 321 is at Patrick AFB and scheduled for flight shortly. The missile was the first to be fired with the new General Electric M1A1 nose cone, a radically different structure designed to carry the without ditch through the

Navy Sets Polaris Flight Test

New York—First flight test of Navy's Polaris 1300 mi. short ballistic missile will be made this fall from USAF's Missile Test Center, Cape Canaveral, Fla. Initial production of the missile will begin next year.

Dr. A. Kirsch, president of Aerojet-General Corp., which makes the solid propellant propellant for Polaris, told a recent meeting of the Society of Automotive Engineers that a number of the engines already have been fired and that test flights are being scheduled.

Kirsch also said Aerojet recently fired "the largest solid propellant engine which has ever been made, and we plan on firing an even larger one within the next 18 days." A similar claim also was made recently by Thiokol Chemical Corp., and one Defense Department official said last week that both statements could be true, "depending upon the day of the week it's made."

critical re-entry period. The nose cone was successfully separated after the missile traveled about 1,500 mi.

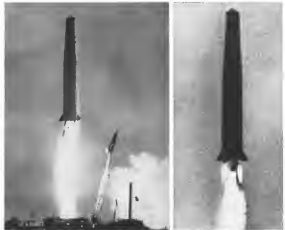
One of the nose cone, Col. Zink said, indicates that the Thor program has entered the final test phase. He expects to have his squadron in England in a few more future, when the unit's main purpose will be to train the

British to operate the Thor.

No decision has yet been reached on the disposition of the first Jupiter squadron. For that matter, re-evaluation of the Jupiter program is still open to question. But Col. Edwards is quite certain that Jupiter production will not be discontinued until at least one Jupiter squadron is in operation.



1964 is a hydraulically tilted to upright position on its transporter-erector missile after an alert is sounded. The transporter-erector is lowered and the missile remains standing alongside servicing crew (left) while being away on flight.



WITH VERNIER and outer engine firing, Thor takes off on first flight test of new nose cone. As missile rises (right), the three nozzles become well defined. Vernier engines continue to fire after sustainer stage.

Bill Demands Cut in Defense Secretaries

Washington—House Armed Services Committee will begin hearings early next month on legislation that would slash the number of Pentagon secretaries, jobs from 24 to 15.

The measure reorganizing the Defense Department was proposed by Rep. Carl Vinson (D-Ga.), chairman of the committee, Rep. Louis Armistead (R-Md.) ranking Republican, and Rep. Paul Kilday (D-Tex.), chairman of the subcommittee on organization, after six weeks of testimony on the defense program.

Committee Proposals

The measure would:

- Abolish four Assistant Secretary of Defense positions for Public Affairs, for International Security Affairs, for Health and Medical Affairs and for Civil Control.

- Merge the posts of Assistant Secretary for Properties and Installations and Assistant Secretary for Supply and Logistics into an Assistant Secretary for Material Requirements. The three other assistant secretaries would be for Research and Engineering, for Manpower and Reserve, and Comptroller in all present.

- Abolish the Under Secretary and one of the present four Assistant Secretaries of Army, Navy and Air Force.
- Slash the number of offices as placed in the office of Secretary of Defense from 2,468 to a maximum of 600. The measure estimated that firm will uniformly eliminate an average

number of at least one position.

- Make the members of the three military services as well as the Secretary of Defense, regular members of the top policy-making National Security Council.

- Run the comptroller from supervising or controlling military program.

- Strengthen the authority of the Joint Chiefs of Staff over unified commands.

- Limit tours on the Joint Staff to three years except in time of war. In a joint statement, Vinson, Armistead and Kilday declared that the "well knit" present of special staff officers who would be increasingly isolated from military reality, and second, it will provide for an inflow of current and outside military experience to the Joint Chiefs of Staff and an inflow to the operational commands of officers experienced in military planning at the national level.

Sponsors' Aims

The three sponsors said the bill "will improve" our national security by changing that will provide a defense system that reacts rather than reacts to events, that reacts rather than reacts to problems and facilitates rather than impedes defense.

Meanwhile, the committee decided into an subcommittee to make a detailed study of Defense Department—how better to protect in military mission. These are:

- Military strength. Headed by Rep.

Carl Albert (D-La.), the group will weigh the adequacy of the military posture of the three services and to arrive independently to meet assigned missions and comply with treaty obligations, evaluate the members of the staff from concept for the foreseeable future, analyze the present combat capabilities of the services to wage war, and, conventional, limited, or total war.

- Organization. In addition to war situations, this group headed by Rep. Kilday will consider the roles and missions of the three services. Because of the difficulty in predicting the effect of new weapons on strategy, Kilday favors giving the Secretary of Defense substantial discretion in the assignment of major roles.

- Order space. A key issue to be considered by this group, which is headed by Rep. Carl Albert (D-La.), is whether military order space programs should continue to be handled by Advanced Research Projects Agency. Legislation enacted Feb. 12 authorizes ARPA to engage in space projects for one year. The subcommittee will also consider the status and progress of missile, astronautical and satellite programs.

- Reserve. This group headed by Rep. Armistead (D-La.) is expected to study military order space programs and the role of Military Air Transport Service's civilian of bases.

- Budget. The policy of upgrading defense funds appropriated by Congress is the main subject this group, headed



First Picture of Piasecki VTOH

Delisted tail rotor model of Piasecki Aircraft Corp.'s new model VTOH for Army shows placement of two main rotors, main rotor and tail rotor, in tandem. The aircraft is designed to carry up to four men and six tons. It also carries a design to permit Piasecki VTOH to be used as a utility helicopter and as a transport helicopter. The aircraft is designed to be used as a transport helicopter. The aircraft is designed to be used as a transport helicopter.

body work which is operated at Philadelphia International Airport to provide standard flight test data. Some 100 test flights are planned for the aircraft. The aircraft is designed to be used as a transport helicopter. The aircraft is designed to be used as a transport helicopter.

by Rep. Philip J. Hoffman (D-Miss.), will consider.

- Procurement. The subcommittee will limit its review of procurement policies to ensure contracts and reports to the legislature from which purchases as well as service representatives. In addition, the subcommittee, headed by Rep. Edward Brooke (D-La.), will review, coordinate and disseminate policies particularly on major defense programs are scheduled to start March 15.

Vinson and Armistead are co-chairmen of each subcommittee. All hearings will be held in executive session.

Boeing, United Report Billion Dollar Sales

New York—Two more major companies report the billion dollar 1957 sales for last year—Boeing Aircraft Co. and United Aircraft Corp. United Aircraft reported the billion mark for the first time, but it was the second year as a new record for Boeing.

Boeing's sales total—\$1,396,926,717—was a percentage record for a major company, although Canadian-Wright Corp. in 1944 reported a total of \$1,716,934,777.

United Aircraft's net income for 1957 was a record for American companies.

Boeing consolidated net earnings of \$13,166,108 topped a previous record of \$43 million run up by Curtiss Wright in 1956 and topped the company's own 1954 earnings of \$17,052,473.

These are the third and fourth annual comparisons to top the billion dollar sales mark for 1957.

Douglas Aircraft Co. reported \$1,091,364,093 its record combined bill from dollar cost American companies North American Aviation, Inc., reported \$1,261,767,483.

General Dynamics, which includes Convair as well as its own aircraft division, reported sales of \$1,047,558,110 for 1956 and forecast a total of around \$1.1 billion for 1957.

Douglas earnings of \$18 million surpassed a deficit. Boeing is the only major company to report a profit for the first time in 1957.

Altogether, earnings in 1957 amounted to 2.39 cents per share dollar

compared to 1.19 cents the year before Boeing said.

The reasons cited reflect the current economic climate to some extent and go back to the government's fixed military and defense but some reason—some profit margin in the current type level price controls, increased interest charges, increased operating charges on new facilities and the write off of \$17 million for development and general expenses of experimental programs.

United Aircraft annual sales of \$1,257,918,315 were a 29% increase over the 1956 total of \$972,597,142. Net income in 1956 was \$17,052,473 or 53.37 a cent share compared with 97.80 a cent share in 1957.

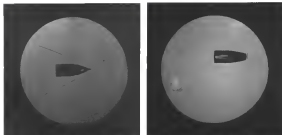
As at the end of Douglas (AW March 5, p. 112), United Aircraft reported a drop in backlog from \$1,300,000,000 to \$1,577,000,000. Boeing reported a backlog of \$2,012,000,000 with \$792,000,000 applicable to new aircraft sales.

Impact of money is being noted in most aviation annual reports, but United Aircraft commented "It is still one hell of a business, however, as stated in our 1956 report, that the missile will not displace the manned aircraft as the foreseeable future and most probably will never do so."



FJ-4F Equipped With Supplemental Rocket Engine

North American FJ-4F fighter has been modified to accommodate All rocket engine, designed and developed by Rocketdyne Division of North American Aviation Inc. All F-4 is modified to fit 150 lb. Boost Wight J57 W-4 rocket engine. Flight's new engine added thrust for the first time at Naval Air Test Center, Patuxent River, Md. Rocket is using hydrogen peroxide and JP-4 as fuels.



SHADOWGRAPH (left) clearly "stops" 22 bullet trailing 4,300 fps. Exposure of 81 microsecond was taken with synchronized spark light source of 0.12 in. dia. and 2-in. Kerr cell. Right, same setup test with synchronized flash lighting "stops" 22 bullet trailing 4,300 fps

Shutter Improves Shock Wave Photos

Wind tunnel and ballistic range photographs capable of freezing shock waves and ballistic projectiles at speeds to 0.01 microseconds have been enhanced with a Kerr cell electrooptical shutter and pulse generator designed by Avco Manufacturing Corp.

Kerr cell shutters permit light when an applied electroosmotic field causes polarization of incident light so that it passes through a polarized filter.

Because the shutter is triggered by an electrical pulse, it can operate up to 50 times faster than conventional systems such as the Schlieren camera which depends upon detection of a flash of light.

Shutter has been developed by the company's Research and Advanced Development Division for aerodynamic studies of long range missile reentry problems where exposure times of 10⁻⁷ to 10⁻⁸ are required to prevent image blur of scaled down high velocity projectiles.

Avco has contract for development of the Titan ICBM missile reentry nose cone.

Two principal advantages of the electrooptical technique are:

- High speed. Rise and decay time of light flash used to achieve high speed photographs is almost instant; exposure times speed to about 0.1 microsecond. Kerr cell shutter is faster because max delay time of required electrical pulse is about 10 times faster.

• Fast lighting. While Schlieren or shadowgraph techniques suffer from detection of the model in perspective to obtain shock wave definition, the Kerr cell shutter can be used in combination to provide front lighting of the subject and back lighting to define shock waves.

Applications of the technique include ballistic projectile photographs, shock wave formation studies in wind tunnels, high explosion studies, spark gap and exploding wire studies, and model studies in high intensity air where high speed exposures build back the cell.



MAILED square Kerr cell produced by Avco has permitted exposure times to 60 microseconds

intensity of models exposed to hot plasma.

Electrooptical shutter consists of three elements:

- **Pulsator.** Light incident upon the shutter is polarized by a filter in front of the Kerr cell. Characteristic of the filter limit angle of incident light to about 10 deg, providing a limiting aperture of about 1/2 in. Glycerin immersion lens of the shutter adds about four times longer electric aperture to 1/16 in.

• **Analyzers.** Behind the Kerr cell is a second polarizing filter angled 90 deg from the first. With an object applied to the cell—the "cell" condition—light polarized by the first filter will not pass through the second. The two filters are not completely opaque but do provide a transmission ratio of about 70,000 to 1 with cross-polarized, unaided viewing, natural.

• **Kerr cell.** Between the two filters a electroosmotic-filled cell provides 90 deg phase rotation of the electroosmotic light vector when a current pulse is applied. Electric field required to produce the rotation lies between 10 to 15 kilovolts per centimeter; 5 cm aperture requires 50 to 75 kilovolts applied to the Kerr cell plates.

Dimensions of the complete shutter, including the pulse generator and a specially designed spark gap which provides the driving signal, are 12 x 12 x 5 in. Shutter requires an external 0.50 kilovolt power supply and a low volt age trigger source.

French May Receive F-100Cs From U.S.

Paris-United States is quickly preparing to turn over to the French Air Force several squadrons of North American F-100C Super Sabre fighters to help shore up France's aging NATO air contribution.

The F-100C fighters will be supplied to France as of the start of next year under U.S. military aid program. Move made the fact that the U.S. has supplied any NATO ally with supersonic F-100Cs. North American fighter is the latest type equipment being used in NATO units in Europe.

France-Algeria deal is being described in Paris as agreed by both the United States and French military officials. However, AVIATION WEEK has learned that at least two squadrons of F-100Cs representing about 50 aircraft are involved in the quiet hitch being turned over to the French Air Force will be used to replace the obsolete Dassault Mirage fighters as well as to supplement the French indigenous Super Mirage jet line, covering off the production loss.

More reason for official interest in receiving the F-100C agreement is current complaints in the United States that the use of the French Air Force of U.S. supplied aircraft in the North African theater. Observers with larger memories also have cited French Air Force use of U.S. supplied Republic F-84s in the Suez campaign.

Both France and the U.S. have been high in the United States, American and French officials understandably want to keep the new agreement quiet for the time being.

Crash Kills First F-104 Unit Commander

Commander of the first operational Lockheed F-104 squadron, Lt. Col. Ken Erwin, was killed last week during a GCA approach at Hamilton AFB, Calif., where his unit, the 48th Fighter Interceptor Squadron, an Air Force Command, is based.

The aircraft was at an altitude of 180,000 ft when it abruptly disappeared from the radar screen's sight. The wreckage was found in San Francisco Bay. The General Electric J79 engine was found here and was found with the aft fuselage section.

Wreckage was taken to the Alameda Naval Air Station for investigation. Col. Erwin had checked out on the F-104 to lead the aircraft's next six operational sorties last month, and had made considerable jet time and jet pilot experience.

Further reason for keeping the agreement under wraps is that it comes at a time when the French Air Force, because of its role in the Algerian war, is rapidly losing its capability to sustain an significant NATO air effort in Europe. Evidence now cropping up in newspaper front section reveals that the suspension of the Algerian war has resulted in serious deterioration of French Air Force jet pilot training and operational flights and even abandonment of several radar stations in Algeria.

Much of this evidence was supplied on the floor of the National Assembly during recent debate on the air force budget. Budget has been fixed at 335 billion francs, which represents a reduction of about 25% from the 1977 budget. Most important, French Air Force manpower strength is being pared to 125,000 men during 1978 from the 1977 figure of 163,000. French Air Force officials have stated that the maximum manpower level needed in order to cover out both NATO and Algerian air duties would be at least 150,000 men.

Manpower situation is even more complicated by a recent shift of an additional 10,000 air force personnel into industry tasks in Algeria. Most of these men had been in the air force at least a year and were considered such recent working on French Air Force jet bases and radar stations in France and Germany.

The budget figures on such a scale as a nation had been seen in the past. France, according to the Air Ministry, would be required to make such a serious decision that unless the figure was revised upward, the French Air Force will be proceeded before the end of the year.

U.S. Chemical Milling Acquires Missile-Air

United States Chemical Milling Corp., Alhambra, Calif., contract fabricating and weight removing; sub-contractors for the aircraft and missile industry has acquired Missile Air, Los Angeles area, missile manufacturing company. Move is part of an expansion program.

Facilities, made for an unindustrialized environment, is intended to broaden U.S. Chemical Milling's capabilities in processing, cleaning and finishing and metal fabricating techniques. Missile Air, in addition to manufacturing aircraft and spacecraft equipment, produces missile and aircraft test beds, general fabrication equipment, control apparatus and sub-instruments.

Acquisition of Missile Air will expand U.S. Chemical Milling to over 200,000 sq ft of workspace.

News Digest

Reaction Motors, Inc. is stepping up development work on the rocket engine for the North American X-15. The engine, now fully designed, is now undergoing development testing at company's facilities in Downville, N.J.

Lockheed's second J79 jet engine will be rolled out this month. Firm has closed that the first test, now under going Air Force testing, exceeded speeds of 518 mph, and cruised at 45,000 ft during engine tests. Both second and third engines are test prototype Caravelle-777 test engines.

Rolls-Royce Tyne turbo-prop engines will power RC-130s. Canadian CL-44 transports, replacing aircraft planned for the Canadian Air Force, will be powered by Tyne engines. Development of Tyne engines is being supported by Queen's development project. The move, which will give Rolls-Royce estimated \$2 million contract.

Kassam Aircraft Corporation received a two cents per hour contract for maintenance last week at the Boeing Company's Renton, Wash. factory. The contract is for a two year period, starting in 1977, which will be added to have per hour at the rate's end, totaling seven cents per hour.

Hemlock Foodco. Co. has started a chemical processing plant within an explosives development. The plant will design, develop and produce solid propellant rocket engines.

New Talos Version

Washington-Talos or version of the Navy's Talos missile system is set to be upgraded with a range of approximately 50 mi and is scheduled to be operational about next year.

Capt. Leslie Scott, of Navy's Bureau of Ordnance, told House Appropriations Committee in Fiscal 1978 budget hearing that since this is a half a dozen of the follow-on version have been test fired.

Capt. Scott did not give the range of the follow-on missile but it would double that of the present Talos which has a range of about 40 mi.

The Bureau of Ordnance official said that, although the Talos is primarily a surface-to-air missile, the Navy has the capability of using it against other surface targets at sea, or, in fact, in land. He added that the missile is also being evaluated for possible anti-ballistic missile mode capabilities.

Tension Rises in Pilot-Engineer Dispute

Feet finding board's decision would set precedent for jet-age negotiations between carriers, crews.

New York—Dispute between airline pilots and flight engineers, a serious threat to jet-age negotiations between carriers and their crews, continued to build up steam last week in the wake of these developments:

- **Presidential feet finding board emergency hearings in Flight Engineers International Union Eastern Air Lines** struggle resumed in Miami after moving from New York.

- **Western Air Lines**, its pilots cut its strike as other issues, sought settlement of the presidential question now to avoid trouble when the airline begins operating turboprops.

- **Third-man-in-cockpit** theme brought thrust into contract discussions between several airlines, the Engineers union under Air Line Pilots Assn.
- **Special subcommittee of AFL-CIO** found it "impossible" that the two associations merge to handle the flight duties of new turbine aircraft. The pilots expressed willingness to accept but the engineers refused.

Board's Task

The feet finding board in the Eastern case, which also will hear an ALPA-Eastern dispute over new contract

terms, has an important and difficult task in deciding whether the airline should speak contractually whether the third man in turbine cockpit shall be mechanic-qualified or pilot-qualified. The board's decision is certain to have an *incisive* side effect on other negotiations involving the presidential issue. The flight engineers insist that Eastern specify mechanic engineers, and ALPA demands that Eastern specify pilot engineers.

AFL-CIO President George Meany on Feb. 5 appended a subcommittee to consider charges filed last December by the flight engineers, who charged that ALPA cooperated with employers by encouraging ALPA members to shun flight engineer incomes in order to weaken the engineers' bargaining position, and that ALPA was interfering in membership of ALPA's program had support of AFL-CIO leaders.

The subcommittee's answer to FEIA's charge against ALPA.

"The committee recommends that the airline pilots be instructed to accept the jurisdiction of the flight engineers and refrain from attempting to enlist flight engineers into membership in the ALPA.

"The subcommittee is going over the record facts that this question between these two organizations has come up before."

"The committee feels that the executive council can never resolve the problems of these two organizations until the two organizations themselves sit down and honestly try to find a solution which will be acceptable to both sides."

'One Organization'

In another action of the subcommittee report, dealing with flight crew complements, the three AFL-CIO vice presidents found that "the close relationship of the flight crew which is now faced with the introduction of an entirely new class of large and faster aircraft powered with turbine engines, makes it imperative that the flight crew belong to only one organization."

The subcommittee, meanwhile, its members reported, that the captain or pilot in command of an airline has full responsibility for its safe operation.

The responsibility placed directly on the pilot by virtue of his license cannot be delegated to his employer or anyone else, the subcommittee noted, and this also makes it necessary that flight crews be coordinated into one organization.

There is no trade union means why



ROLLOUT of steady stream Douglas DC-8s, third of U.S. dual turbine transports, underscores importance of ALPA/FEIA jurisdictional struggle. DC-8s mean engines, landing and taking off, but, we moved out to representing in dual assembly handling.

the merger of these two organizations could become a reality," the report said. It also pointed out that Meany had advised ALPA in Miami, 1977, that AFL-CIO would assist in bringing about an amicable solution to the dispute. This offer should be accepted, the subcommittee added because of technological changes in the field of aircraft propulsion.

ALPA President G. N. Sreen has advised Meany that the pilots are prepared "to begin merger discussions immediately." FEIA President George R. Pettit, Jr., announced later that he was "based on a condition of an executive committee not to discuss merger with any other union. We are an international union with a recognized charter and no arbitrary decision can be made to merge. The Pettit statement followed a conference in Chicago by ALPA First Vice President G. M. Lencucha that Pettit had not been heard from after Sreen had suggested his willingness to talk, except the third crew member was established by government regulation in 1946, the AFL-CIO report noted, with the advent of large, faster, more complex aircraft.

Some airlines assigned mechanics, some assigned pilots, and some assigned both to the new category. The third crew member is a new category represented by FEIA (about 50% of the total), ALPA and in one case by International Association of Machinists.

ALPA's policy for crew complement on turbine-powered aircraft was set by the association's directors at a meeting

in November, 1956. Single between the two unions began previously.

FEIA last year generated Trans World Airlines with a detailed paper spelling out the duties of flight engineers on turbine aircraft, as FEIA sees them (AWN Nov. 15, p. 47). The flight engineers agree that their duties will be greater as jets and the pilots' duties less. ALPA takes opposite view.

Among points at issue:

- **Pilot management—Engineers.** They will be required to keep full knowledge of logs and center of gravity computa-

tions. Fuel management is more critical and more exciting in jet operation, and this job is one of the flight engineer's present responsibilities. Pilot fuel management as a job is simplicity itself, but it is essential, obviously, in flight. "Surely, we can tell which we have the right or left hand pump as to read... unbalance..."

- **Electrical systems—Engineers.** Systems in the 707 has 17 times as many cockpit instruments dials and controls as the average piston transport, emergency procedures involving electri-

Comet IV Gets Idlewild Landing Rights

New York—First of New York Authority closed the de Havilland Comet IV for limited operation at New York International Airport. The airport, as well as Newark, LaGuardia and Teterboro, has been off limits to most transports by a long-standing Port Authority ruling based on noise considerations.

An order model of the Coast operated by Royal Canadian Air Force was dropped Feb. 14 at Idlewild. Port Authority spokesman for Comet IV flight specifies that the four-jet transport be equipped with Rolls-Royce turbo engines for its RA-29 Avon engines. Eight-hourly transatlantic flights will be allowed under VFR conditions, and will be subject to preferential runway assignment under National Air Transport Coordinating Committee extensive procedures for the New York area.

The Port Authority and its associated committee named Comet IV noise at Heathrow, England, and issued the place quarter three present DC-10 and Super Constellation. Comet's appearance ended the overall state of the strength by about four to six decibels, the Port Authority said.

Low frequency thrust noise of the piston transports was about 18 decibels higher than the Comet's noise, while high frequency thrust noise was about five decibels higher in the Comet.

Turboprop transports previously denied by the Port Authority include the Valiant Viscount, Lockheed L-100 and Boeing VC-97. The two-jet, unpowered Sud Aviation Caravelle also has been denied acceptable by the agency.



DC-8 COCKPIT looking out with flight engineer's duties at right was never subject of emergency hearing.



CONQUEST 505 light engine's station (right) and Boeing 707 engine position were pictured in exhibits

of failures will require extensive knowledge by the engine of the location of components and their functions. Pilots, although deprived of visual aids, are trained substantially, to have greatest knowledge of engine operation. Various engine models are more completely self-tuning, and failures are less critical than in some present systems.

• **Ancestral engine—**Engineers—Engineers: Monitoring of engines is a traditionally skilled engineer on some of existing engines or tests and have them repaired on the ground before they reach the danger point, conventional information is being obtained to prevent turbo-propulsion malfunctions or engine failures. Pilots: The conventional system is a warning of a component failure, what could a flight engineer do about that? A pilot's role?

• **Present engine—**Engineers: Turbine engines are now available to service new conditions and are not heavily adapted to handling such as turbo-propulsion engines must be converted to can run this, and a demand specialist is needed to do this job. Pilots: The instruments for detecting are on the pilot's control panel and the engine bleed air anti-icing switch is on his overhead panel.

Western issue

Western pilots want an article [p. 2] as working conditions and pay is not. The final data question is a point of dispute in current negotiations, but is not according to the National Mediation Board, a strike issue.

ALPA wants the crew issue to remain open until some time between the end

of this year and 90 days before Western's Lockheed Electra turboprops are put into service. Then the pilots would like to begin negotiations on the point.

Western anticipates a production dispute between the ALPA and FEHA when the Electra starts and wants to settle the issue now. The airlines currently could be in an uncomfortable position with a fleet of new airplanes and untested crew problems. Western asked the mediator board to set up a fact finding board similar to that handling the dispute with Eastern. The board, however, refused to ask President Eisenhower to set up the commission staff, holding that the union are not comparable and that ALPA and Western should resolve their differences on the Federal Labor Act.

FEHA President Peter sent the National Mediation Board on Feb. 15 that his union would resist an emergency fact finding board if the Western pilots demanded contractual control of the engines as a condition of working hours.

Mediation Board Secretary E. C. Thompson replied to Peter that "National Mediation Board has no knowledge of any demand of Western Air Line pilots as a condition of their return to work that they be given contractual control over the handling rights and qualifications of flight engineers on Western Air Lines."

The two cases differ in at least one respect. Eastern's contracts with both unions are expired and new ones must be signed, whereas Westerns last year signed a contract with FEHA.

Western's new code in Mexico City

is causing part of the trouble with its pilot. A low wage is possible for the Boeing flight plan to cover of such lawsuits as announced by a foreign government oil date upon in Mexico and. The pilot says they are asking that their working conditions simply be brought up to the standard of other airlines. American Airlines, according to the pilots, does not provide extra pay for an Alaska run but does cover the other aspect of foreign duty.

Western's management feels that ALPA's demands would cost the airline \$6.5 million annually, a 1975 increase in expenses. If costs were the same as last year, the increase would eliminate any possibility of do-it-yourself in national airports, according to Western.

Regarding the Western strike, a pilot spokesman said "ALPA is settling down for a long haul on this one."

Visitation Agreement

ALPA and Continental Air Lines recently agreed a new contract which includes a pay scale for Viscount 812 pilots. Eighteen engines, four turbo-propellers with 11,145 hours, will operate 11,145 a month. The Viscounts, because of their size, will not get any more in the production line as not required.

In addition to Western and Eastern, the pilots are working new contracts with American and Northwest Airlines. Negotiations with American have been in motion and ALPA and recently it was "temporarily considering a withdrawal from service."

The pilots want two contracts with American, one covering pilot planes and one covering turbine planes. This approach is a maneuver to shut the third case out for the time being. American, however, can be expected to hold out for a single contract.

and one covering turbine. This approach is a maneuver to shut the third case out for the time being. American, however, can be expected to hold out for a single contract.

Inner World Airlines and ALPA expect to begin contract talks this summer. TWA has been studying the third case since and probably will decide for itself when type of qualifications it will require.

The flight engineer's association, in addition to Eastern, is negotiating with TWA (as mentioned), Continental (as mentioned) and United Air Lines (as mentioned). Negotiations with American will open soon, and contract with Southwest and Western will be completed next month.

BOAC Seeks Routes Across Russia, China

London-British Overseas Airways Corp. has asked the Ministry of Transport and Civil Aviation to negotiate for BOAC routes across Russia and Communist China.

Negotiations must be at government level, BOAC says, and route plans will already have been submitted to the British government.

A possible route, London-Moscow-Peking-Lahore, would save about a day over the present London-Rangoon-Bangkok-Tientsin route.

Production 707 Logs 47 Flight Test Hours

Boeing, Wash.-based, Airplane Co.'s first production 707 jet transport logged 47 hr. 8 min. during its first test flight, Boeing says. Highest altitude reached was 35,000 ft.

The airplane climbed to speeds above 500 mph and at altitudes above 35,000 ft. during the first phase of its flight testing. Boeing says. Highest altitude reached was 35,000 ft.

Tests included a flight with a weather front over the Pacific to check the 707's automatic system. With Gulf Stream II aircraft, Airplane personnel added, these flights of test were allowed to collect on the plane while wing and tail airframe system remained first off. No adverse characteristics were noted during the test, according to Boeing.

Other tests of the production prototype have included various loadings and instrument landing system checks. As of last week the airplane had made a total of 28 flights.

Test pilot James H. Gamett says the airplane comes fully up to expectations, and that only minor adjustments have been necessary.

High Jet Engine Overhaul Costs Detailed by American Official

By L. L. Doty

Washington—Possibility that jet engine overhaul costs for transport aircraft may actually run as high as \$70,000 per engine and overhaul time as low as 600 hr. has been cited by William Littlewood, vice president of equipment research for American Airlines.

Testimony of the Civil Aeronautics Board's General Passenger Panel Littlewood, Littlewood said, low overhaul costs of turbine engines may be slightly lower than piston engine costs but that overhaul costs will be substantially higher. He added that the "adequate element" will be the cost of materials replacement which may be very high.

Other highlights of Littlewood's testimony:

- Complexity of accessory and control equipment of turbine engines will increase overhaul costs.
- Cost of jet fuels will likely climb to a level comparable to present costs of gasoline.
- Investment losses in models of jet transports will be subjected to a new

low of changes. Littlewood and plans to revise cost presentation of information to pilots "are related in this area."

• Succession to jet transports now in order are not likely to appear until 1975. Succession of jet transports may appear about 1975 for low drag, high speed service.

• Markets for used low-engine equipment, particularly the DC-8 and DC-7 series, will become larger as the rate of development of new aircraft continues to increase.

Overhaul Costs

Littlewood and the Air Force cost of a Pratt & Whitney JT5 turbojet engine, cost about \$70,000 and added "We hope to better that, but we may have to start at this point." He said overhaul time will probably begin at 600 hr. as against the some 2,000 hr. maximum now attained on piston engines. He also says he expects that a starting point of 3,000 hr. may prove feasible.

The American official pointed out that labor costs are generally high and parts cost is generally moderate in the overhaul of reciprocating engines but that the converse will be true as the overhaul of jet engines.

He said, "The one thing you can't tolerate is a jet engine with an high engine speeds in internal failure and, in order to prevent these, there will certainly be a strong tendency to lean over backward in parts replacement, and the parts of course, are quite expensive."

Asked if jet transports will be more efficient than piston engine aircraft, Littlewood said the two types are roughly efficient per unit of product. He said that jet airplanes will be roughly the same as piston engine aircraft will provide a better and faster service, which he added, is the "real" for being able to operate jets at the same cost.

"We would like to do it at a lower cost, but it is not possible," he said. Littlewood stressed that there will be little if any discontinuity in the performance factor of jet transports although he pointed out that last year there were 92 and 94 increases in the March locations on proposed aircraft.

He stressed that this was a needed improvement in performance and that there is still a slight potential improvement in performance. He said that March 92 or 94 in March 1971 had warned that the margin of safety is reduced as performance gets closer to Mach 2.

Slack Asks Suspension

Slack, Airways, Inc., has asked the Civil Aeronautics Board for authority to suspend its scheduled services until Jan. 1, 1975. David W. Slack, chairman of the board and president of the all-cargo carrier, told the Board that Slack had not substantial loss of money over the past year and a half which it has not been able to recover from other airlines, such as charter work.

Although the application requested temporary suspension in order to permit him to build back his company, he said that Slack had not been able to recover from other airlines, such as charter work.

On its scheduled all-cargo route, which includes transcontinental service, Slack lost \$3,114,000 in the year ended last June 30, the Board was told. Total losses from the same period were \$2,312,000. From June 30 to Feb. 1, total loss for all operations was \$1,208,000, the carrier said.

Slack stressed the Board's policies for a good deal of the trouble, contending that CAB "has imposed itself as a potential responsibility in connection with the development of all-cargo carriers in this country."

It, and that abandonment of jet transports could result from negative results in economic operation. In the case of maintenance and materials, he quoted one manufacturing official as saying that the rate of abandonment is a factor higher than the rate during World War II because of work being done in research and development.

On that point, he said that such programs in structural design and fabrication can be expected. Pushing out that sort of construction as an end in itself, he said, "is not a good idea," but that "very unique methods may come day" be developed to do some of the things which are now being done in very expensive methods.

Latter-day hopes to see savings in aircraft weight through the improvement of manufacturing methods. He said that Pratt & Whitney has indicated that an engine designed for transport service is not subject to the Ground Breakers required of a military engine. As a result, he said, the present limit of 10,000 lb. to achieve the actual engine weight of about 700 lb. without changing the design of the compressor, combustor or the turbine.

Denny Defends CAB In Letter to Harris

Washington—Civil Aeronautics Board member Elmer D. Denny last week denied that Skirmish Adams, chief general counsel, attempted to influence the Board in the North American Airlines case.

In a letter addressed to Roy Owen Harris, D.D., A.A., Chairman of the House Subcommittee on Oversight, Denny labeled charges by Dr. Bernard Schwartz, former subcommittee counsel, that Adams had attempted to influence the Board as "completely false" and "more than belittling." Denny said that references by Schwartz to two letters written by Adams to Martin Chabersky, representing North American, implied that Adams may have tampered, as charged to influence the Board in the referenced proceeding against the non-direct airline.

Denny emphasized "there was no pressure or suggestion from the White House as to the course the proceeding should take or the action that the Board should take" and added:

"There was simply a request for an advisory opinion which, in the light of the serious charges which had been made by North American in its widespread campaign, seems to me to be a wholly reasonable one."

North American went out of court one week last year when the Supreme Court denied a petition for certiorari to clear a four year struggle by the Board to clamp down on the carrier for a

South African 707s

South African Airways will order three Boeing 707-320 long range jets. Transport Minister Eric Swales announced recently. He said the order will be placed immediately.

The three aircraft are to be sent to Europe and Australia in addition to the domestic regional service. Johannesburg-Aden flight time with the jets would be about 10 to 11 hours against the present 21 hr. Joe Sison, International Airport in support will run a new service between Aden and Cape of Good Hope in 1969-70, long as capable of handling aircraft up to 200 tons.

series of alleged violations of regulations.

In his letter to Harris Denny denied he had suggested to Adams that "the way to solve the case was for North American to go into court and let the case go to court proceedings." He said that he had suggested such a step only as a last resort. He said that the Board was trying to outpace its own conference action.

The facts are that the Board was stuck on continuing its enforcement action despite North American's attempts to improve it," he said.

Denny said he has no recollection of ever talking to Adams about the case. He said that he had sent Charles White, White House staff member, a copy of a letter to Sen. Edward Brooke (R., Mass.), explaining the procedure being followed in the case and added that the letter from Adams to Chabersky was "probably" based on material in the letter to Harris.

He accused Schwartz of ignoring the facts and added:

"It apparently did not occur to Dr. Schwartz that it is absurd to suppose that it was necessary for the Board to point out to North American or to Mr. Chabersky that the courts are available and that court action is one way to obtain a ruling. In this connection, I would like to point out that North American needed no instruction as the line of action of appealing to the courts."

Russian Proposes Medium Transport

Moscow—Russian designer O. K. Antonov has called on the government to authorize construction of a "35-40 passenger airplane with excellent load-carrying and takeoff characteristics in order to permit service between medium and small size towns having poorly equipped airfields." The craft would help fill the equipment gap between Antonov's seven-passenger An-24 (Lilje Bear) light transport, which now is undergoing tests, and the large

su-26 Soviet lightjet and turboprop airplanes which seat a maximum of 50 passengers.

American Revamps Sales Department

New York—American Airlines will make a series of major revisions in the structure of its sales department April 1 when C. A. Richardson reports the carrier as executive vice president roles (AW Feb. 24, p. 38).

The new organizational pattern is designed to strengthen American's sales effort by placing all sales functions and customer service under one head. Changes include the establishment of a new Sales Service Department that will combine a number of functions now handled by customer service.

Public Relations will now report to Richardson but overall policy for the airline will continue to be directed by President C. M. Smith. At a later time, all association offices will report directly to sales. Airport duties will be separated between operations and sales departments with a view toward placing ticket counter and other customer sales roles.

C. R. Speer will serve directly under Richardson as senior vice president. Divisions and titles under the new arrangement are:

Vice president, advertising, vice president, cargo sales, vice president, passenger sales, vice president, passenger sales service, assistant vice president, individual vice president, relations, domestic, sales budgets, regional sales president.

Five divisions will be established under the Passenger Sales Service Department, headed by C. M. Smith. They are: flight standards division, ticketing and terminal division, reservations division, customer correspondence branch and sales expansion research division.

Red China to Expand Civil Air Transport

Moscow—Communist China has ordered its Civil Air Fleet Administration to increase traffic 20-100% under the nation's Second Five-Year Plan (1958-62).

Development program also provides for introducing Soviet-built turboprop and turboprop aircraft on Red Chinese air routes. Present equipment consists of Russian D-14-4, D-12s and D-2s.

During 1957, last year of the First Five-Year Plan, Communist China's overall commercial air traffic was three and one-half times the 1952 volume, according to an official report.

National to Construct Hydrant Fuel System

Construction of an underground hydrant fueling system for jet aircraft has been started by National Airlines at Miami International Airport.

Fueling system first of its kind to be built at the Miami airport will have a total delivery capacity of 3,000 gal./min. to supply four hydrants-two for jet fuel and two for piston engine fuel. When not in use, underground hydrants will be hidden with flush coverings strong enough to support the 355,000 lb. weight of a DC-8.

Initially, 470,000 gal. storage tankage will be built at a cost of \$180,000. This will be increased to a total capacity of 1,350,000 gal. at an additional cost of \$100,000. Hydrant system, with its two miles of underground piping, will cost \$500,000.

Fuel will be delivered from hydrant lines by a small pumping tank. National estimates that in 1962 when its entire fleet of six DC-8s and 21 Lockheed Electra turboprops will be in full operation, annual fuel consumption at Miami will be approximately 70-million gallons.

SHORTLINES

American Airlines will lease and operate a short line meter office in the new 570 room Time & Life Building near the corner of 70 St. and Avenue of the Americas in New York City. Occupancy of the new office is scheduled for sometime in the fall of 1959. American will continue to operate its ticket facilities at 9 Madison Plaza.

Capital Airlines' proposal to encourage group economy by selling standby tickets at groups of 25 or more at 100% of current individual fares has been favorably accepted by the Civil Aeronautics Board. The new percentage rate would apply to flights scheduled to depart on Saturdays and Tuesdays for standbys that would be considered within seven days. Capital had asked for the right to operate in increments of such groups if operational problems required but CAB voted that a group could not take advantage of the reduced fares if it were split into units of less than 10 persons. The CAB will permit the plan to become effective after Capital accepts the Board's modification.

Civil Aeronautics Administration will use ground facilities to handle initial turboprop transport operations will be provided at Washington National Airport. It is a means to Los Angeles, Chicago.



Continental Viscount Undergoes Tests

First of 15 Viscount 612s to be delivered to Continental Air Lines recently made its first flight from the Viscount Assembly Ltd. airfield in Weybridge, England. Type 612 series has 32 seat interior with two aisles.



Continental Air Lines' first Viscount 612 is shown at test airfield at Weybridge, England, where, together with a Viscount 640, the certification program will be completed.



Two aisles on Viscount 612 seats four passengers. The layout will not be changed during takeoff and landing as a safety precaution.

AIRLINE OBSERVER

► **Boeing Airplane Co.** is front runner in the competition to provide Eastern Air Lines with 11 to 15 medium-range jetliners eventually. In Seattle, East air president Capt. E. W. Ruckelshaus said, "Ireland, without any commitment, the Boeing 730 is closer to what we think we need than the Conquest 880 is." Ruckelshaus noted that Douglas is working on plans for a medium-range jet but added, "Boeing is out in front . . . in its ability to produce fast." Ruckelshaus wants to begin the medium-jet service in mid-1981. Initial orders, which will be placed this year, will amount to \$700 million.

► **Witch for Western Air Lines** to place an order for a fleet of Boeing 730s. The airline considers the medium-range aircraft about the right size for its route structure and wants the aircraft by 1984, a target date Boeing can meet.

► **Post Office Department** has determined that cost of transporting regular three seat mail by air is "amounting to a lot less" than the cost of handling by surface transportation. The cost difference was deduced as a result of a check made following the acquisition of the equipment involving the movement of regular mail order crates on a space available basis. Testimony before a House Appropriations Subcommittee, E. George Seidel, assistant postmaster general, noted that the cost is so low given "even more favorable" because "... all post has been captured whereas there has been no increase in the competition we are trying to displace."

► **President Eisenhower** has named a three-member fact-finding board to investigate the dispute between the International Association of Machinists and their airlines—Eastern, TWA, United, Northwest, Northeast, Capital and National.

► **Air Line Pilots Assn.** will award a portion of dues to members as a dividend on surplus funds in excess of operating expenses and reserve requirements. Refunded dues will total \$106,000 with individual refunds amounting to \$22.5% of the dues paid by each member during 1977.

► **Sidly will contract** on 55 offices international airport at Palermo to handle traffic on Europe/Africa and Overseas Atlantic routes. Airport will cover over 600 acres, include a 10,000 ft by 200 ft runway and will be completed in about three years.

► **Trans-Canada Air Lines** will replace all its DC-3 aircraft in eastern Canada with Vickers Viscounts by July 1.

► **Seawall's Board of Directors** will propose a 50% increase in the company's capital stock issue at a stockholders' meeting April 2. Proposed increase will raise capital from \$9.6 million to \$14.7 million.

► **Charmian** are asking that Airlines Modernization Board programming offer a projected over a five year period although the lesson agree has a legal lifetime of but three years. Meanwhile, ANB is considering Atlantic City as a site for its test center, however in Florida and Oregon also are being studied. ANB will be equipped with 20 civil and military aircraft so that flight experimentation tests for stresses development can be conducted with virtually every type of aircraft now in use.

► **Civil Aeronautics Administration** is sponsoring nation-wide program covering 20th anniversary of the Civil Aeronautics Act of 1938. All aviation agencies and associations are participating in the planning of the program which will be held during the week of June 23 but best plans were formulated by the CAA around month ago. Features of the program will be open house at all CAA facilities throughout the U.S.

► **Aerobics** first regular TWA-04 service between Moscow and Vladivostok is being offered only once every four days until the end of March, when the flight frequency will be increased. Scheduled three in the 1000-mile trans-Siberian route—including stops at Omsk, Irkutsk and Khabarovsk—at about 11 hours.

nucleus of the airport. CAA Administrator James Fife said that airlines waiting to provide jet service to Washington National can use Friendship International Airport, pending completion of Washington's new airport at Clarendon, Va.

► **Delta Air Lines** reports declining traffic during the first months of 1977 and the first few weeks of 1978 has caused the airline to make a downward revision of the forecast volume of 1978 operations. Delta has placed orders totaling over \$500,000 with Collins Radio Co. for airborne weather radar and communication/navigation equipment with deliveries scheduled to begin this month. The order covers equipment, spare and parts for the fleet of Douglas DC-8 and Boeing 747 jet transports ordered by Delta.

► **Ethiopian Airlines** flew a record 87,665 revenue passengers 39,197,000 revenue passenger miles during 1977.

► **Flying Tiger Line** reports it flew 52,986,899 ton miles during 1977, 23% above the 1976 figure. The airline attributed the gain to introduction of the 11 new Lockheed Super-80 Conquesters during 1977.

► **International Air Transport Assn.** has assigned the Bureau World Fair a place on the world network of scheduled airlines. The help-out on the fairground will be known as the "Brazilian World Exposition 1978 Bldgport" with the official designation letters "BWP." The help-out will serve passengers coming to the fair from countries in Belgium, Holland, France and Germany.

► **North Central Airlines** has filed applications with the Civil Aeronautics Board for approximately 525 route miles connecting three U.S. cities with points in three provinces in Canada. The airline wants routes between Minneapolis-St. Paul, Alaska, and Winnipeg, Manitoba, Denver, Colorado, and Seattle, Ore., and Miami, N. D., and Regina, Saskatchewan.

► **Trans World Airlines** has begun construction of a \$5 million maintenance facility and administration building at Los Angeles International Airport. The new center will consist of a 400,000-sq-ft hangar, an adjacent administration building and a separate garage and ground maintenance building. The hangar will be capable of housing up to 100 or 120 jet transport aircraft. Surrounding the hangar is more than one million sq. ft. of pavement, already poured, for parking and servicing positions for 13 aircraft.



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RIGHT PHOTO shows how stainless steel nose cone of Explorer I satellite was formed by Phoenix cold rolling method developed by Lodge & Shipley Co. (left). At right, technician uses a Vernier height gage to check nose length during heating process.

Blunt Stainless Steel Nose Cone Indicates

By George L. Christias

New York—Army's Explorer satellite nose cone, a stainless steel cone 12.231 in. long and 6.125 in. in diameter, is designed with a blunt nose indicating that heating problems are encountered during flight in orbiting stratosphere.

Nose radius is 1,500 in. Cone's wall thickness ranges from .094 in. in center to .017-.011 in. on sides.

Shape serves as a nose cone both for the active Explorer-G, housing main engine during metal acceleration and for the

satellite as its orbit around the Earth.

At least 40 cones have been cast—fabricated to date by Lodge & Shipley Co., Cincinnati, Ohio, under contract to the Army Ballistic Missile Agency, which has ordered 50 more, and Jet Propulsion Laboratory of the California Institute of Technology, which received 10 more. Both organizations were responsible for the development of Jupiter-C and Explorer I (AW, Feb. 10, p. 38).

First satellite, weighing 30.5 lb., was launched on Jan. 31, a second, nose

highly instrumented, Explorer, also weighing 30 lb., will be launched soon.

Stainless steel was selected as the metal best suited for nose cone construction because of its high tensile strength, even when weight restrictions demand the use of thinnest possible gages. Other desirable qualities are high resistance to corrosion and low thermal expansion.

Cone is made of type 416 stainless—the more grade used by the aerospace industry for car trim.

Weight of the complete unit with



TECHNICIAN checks wall thickness of nose cone with a Vialpage ultrasonic probe. Steel of light or medium grade is not indicated with thickness in the chart.

selected surface mechanically or hydraulically, depends the metal parallel to the centerline of the part being formed. This differs from a cold rolling mill which deforms the metal in a longitudinal direction, creating a spiral pattern in the work surface.

Blowover effects of Phoenix on the metal are similar to those of cold roll.

Cone's structure is compressed and rolled, not flow lines are so broken, adding considerable strength and hardness to the shape. No problem in actual points of metal failure are produced by the process and any stresses that are produced can be completely released by standard annealing treatment, according to the manufacturer.

Process also produces a smooth surface on the metal being rolled. Six feet back on the nose cone is as low as 4.5 microns/inch.

Three production steps used to produce the satellite's stainless steel nose cone are:

- **Spinning.** Type 416 stainless steel 304, .094 in. thick is shaped in the center to spin, as a heating point for a 75 day, machined on first Phoenix operation. Base nose cone configuration is obtained by this operation.

- **Control shaping.** Base is finished and nose is annealed to relieve stresses.
- **Cone is spun.** (Finished to completed form except for spin-finishing the cone.)

Final heating of the nose cone's wall thickness is accomplished with a Vialpage ultrasonic vibration testing machine.

Final is on of stainless steel for metal and satellite nose cone operation is indicated by the fact that before Explorer I's nose cone was annealed in a furnace, the instrumented contact used in Project I made this nose cone's wall thickness varied to more than 1,000 in. above the Earth.

Satellite Heating Problem

is suitable to the astronaut package, or 13 in. It is attached to the satellite in 16 1/4 in. bolts.

Atmospheric resistance that the satellite has during its orbiting is being subjected to temperatures of between -100C (-148F) above it in the Earth's shadow, to 1,000C (1,832F) when subjected to direct solar radiation. Figure 1, based on the satellite's design, shows the nose cone and its shape, also of about 1,000 in.

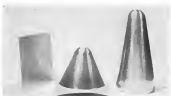
Highly reflective shape of minimum oval or oval on the outside of the

satellite to avoid extremely high temperatures. Final fact that the satellite is spinning gives it an average color of gray.

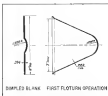
Explorer I is orbiting the Earth at 15,476 mph, in an elliptical orbit whose apogee is 1,587 mi and perigee is 218 mi.

Nose cone is cold-formed by a Lodge & Shipley developed process, called 1-letting.

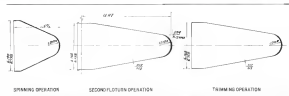
With this process, a metal blank is inserted between a roller and a hot oil-cooled. Action of the roller which is



THREE heating stages of Explorer I's nose cone stainless steel blank .094 in. thick is shaped in the middle, first fluting operation gives basic shape, cone is final form.



FIVE STEPS used by Lodge & Shipley to transform an 8 in. square stainless steel blank into a finished



satellite nose cone. Blank is shaped in order to serve as heating point for 75 day, machined on first Phoenix shaping operation. After

final shaping operation, cone is finished, then given a spinning operation. This is followed by a second Phoenix operation

Largest Special Metals Company Formed

MALLORY-SHARON NOW INTEGRATED PRODUCER OF TITANIUM, ZIRCONIUM, SPECIAL METALS

Mallory-Sharon Titanium Corporation has broadened its scope in the special metals field with acquisition of all the titanium and zirconium sponge production facilities of National Refractories & Chemical Corporation, plus full ownership of Reactive Metals, Inc., formerly owned jointly by Mallory-Sharon and National Refractories.

Our new name is Mallory-Sharon Metals Corporation. Our products include titanium, zirconium, and hafnium in sponge form and in a broad range of mill products including sheet, plate, rod, bar, billets, etc. Planned for the future are other special metals.

LOW COST PROCESS—Now a fully integrated producer, Mallory-Sharon will use the new sodium reduction process for making titanium and zirconium sponges. This process is believed to be the lowest cost method developed to date for this purpose, and produces metal of unusually high ductility. It will contribute to making titanium and zirconium economically attractive in more and more applications.

WHAT THIS MEANS TO YOU—Mallory-Sharon's leadership in the special metals field will mean continuing

improvements and responsiveness to these metals. In addition to titanium's broad use in aircraft and missiles, and zirconium's in the nuclear field, both metals provide exceptional corrosion resistance—offering lower costs in a broad range of processing and industrial applications. Let us help you design ahead with these new metals.



Regular price reductions in titanium and zirconium sponge have also been reflected in lower prices for mill products. This trend shows the results of reducing titanium and zirconium costs for your firm's products.

MALLORY-SHARON

METALS CORPORATION • NILES, OHIO



Integrated producer of Titanium • Zirconium • Special Metals

Douglas Reveals Mach 9 Aircraft Details

Los Angeles—Details of design philosophy evolved by Douglas Aircraft Co., El Segundo Division Inc. in 1951 proposal to Navy for D-555 III research aircraft, plus material closely aligned to DeSoto's proposal in X-15 concept of about one year later, now out-lined last month by Ronald Van Every, chief of aerodynamics.

Highlights of the early proposal for follow-on to the D-555 III aircraft were:

- Original goal of 1 million ft. altitude, slightly above that of cargo, which was modified to a goal of 790,000 ft. and speed of Mach 9.
- Use of blunt leading edge aerobically as one facet of attack on aerodynamic heating problem.
- Refinement of aerodynamic flight controls for control in atmosphere, use of mono-propellant jet reaction controls for out-of-atmosphere control.

Abandon Altitude Goal

Early in this work, Douglas engineers abandoned the extreme altitude goal area. It was not deemed practicable without a rocket booster system, and it was considered best to stick to the mother ship launching system.

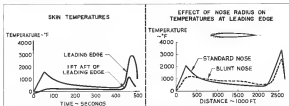
Additionally, calculations indicated that acceleration involved in a climb from the more extreme altitudes would exceed the limitations of the pilot parashuting, taking full advantage of even the mother ship launching system's lift capabilities.

Material taken into consideration was the high temperature super alloys, capable of withstanding aerodynamic heating in static state rather than transient conditions.

Flight path investigation showed a 35 deg. angle of descent was optimum



STRAIGHT WINGS characteristic (see Douglas D-555 III Skyrocket) research aircraft first proposed in 1951 to U. S. Navy. Flight was dropped because of lack of funds. Actual conception shows design philosophy of blunt leading edge shapes to reduce skin friction and resultant aerodynamic heating. Plane would be fitted with conventional jet controls for upper atmosphere flight.



AERODYNAMIC HEATING of D-555 III leading edges would reach 1,000° at 500 sec. (graph at left). Reduction in high temperatures is marked off at leading edges. At right blunt nose configuration temperature effect (dotted line) is compared to standard nose.

TOTAL HORSEPOWER
DELIVERED

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900,000,000

800,000,000

700,000,000

600,000,000

500,000,000

400,000,000

300,000,000

200,000,000

100,000,000

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This amazing horsepower total includes both piston and gas turbine engines for 500 types of aircraft. In all, more than 425,000 engines have been delivered to power leading commercial and military aircraft.

These engines have established the world's highest standards in aircraft power plants. They have made Pratt &

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Today 15 major military aircraft types are powered by Pratt & Whitney Aircraft J-57 and J-75 jet engines. Commercial versions of these efficient, thoroughly proved engines are standard power plants for America's long-range jet transports, the Boeing 707 and Douglas DC-8, and for the medium-range Boeing 720.

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1937

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R-1500



R-1340



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R-2000



R-2600



R-4360



J-46



J-57



J-75

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- Propellant Handling

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6. Montserrat AAFB
7. Grand Turk AAFB
8. Dominica AAFB
9. Mayaguez AAFB
10. St. John AAFB
11. Fort de France AAFB
12. Antigua AAFB
13. Recife

SOUTH AMERICA

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GUIDED MISSILES RANGE DIVISION

Patrick AFB, Cocoa Beach, Florida

in a steeping point, would support 30,000 acceleration at re-entry point, would achieve the 750,000 ft. altitude and velocities of the order of 8,000 f.p.s. Minimum angle obtained was 10 degrees at 84 deg., but resulted in too high accelerations at re-entry point.

Losses of what was termed the "re-entry of continuous flight" were calculated, using a maximum speed of 370 mph, at one level in plans utilizing aerodynamic lift, while the other side of the equation was bounded by aerodynamic heating at high Mach numbers. In configuring the D-558-HI, Douglas proceeded on the philosophy that lift/drag, and its effects on boundary layer, would contribute to reduction in aerodynamic heating. Additionally, the time at elevated temperatures was calculated, results showing an interval of the order of 18 sec. at levels approximating 2,000°.

Other considerations were that Maassius (a modified Clark Y) used with elliptical nose section was estimated would play no part in the craft's performance in the out-of-atmosphere segment it was intended to investigate. The Maassius would keep landing speeds in the lower range, rather than those in higher class resulting from thus supersonic inlet shapes.

Other out-of-atmosphere considerations were that plane's capabilities as this segment would be the product of thrust weight ratio rather than low drag, due to absence of aerodynamic drag.

Heating Probe

Aerodynamic heating investigation covered, in addition to blunt shape contribution to heat induction, the possibilities of using insulation coating on surface in combination with suitable materials. Research into insulation materials and techniques was begun. It was noted that while highest temperatures were reached at wing leading edge (Maassius poorly, more typical values were obtained one foot behind the leading edge, and a core part of it about equivalent mentioned earlier).

A strong part of the proposal covered through construction blunt shapes to make sure along a large portion of tail drag, reducing thus friction and as associated aerodynamic heating. The report noted that much research remained to be done in order to precisely predict Maassius effects on boundary layer to the level required for building as useful wing on this form.

Stabilities and control problems in the atmosphere were deemed mostly exaggerated forms of known phenomena as concerned on aircraft force fitting in the low supersonic regime. While the D-558-HI configuration had the horizontal stabilizer located above wing chord line, further investigation showed that optimum location for the X-15 configuration entry would be on or close to an extension of the wing chord line.

Adoptive appointment of vertical stabilization surface above and below fuselage (control fin) also was seen in the entry into the X-15 configuration.

Solid Propellant Growth Cited In Formation of Oxidizer Firm

Hoodin Electrochemical Co. and Foster-McClellan Co. have added another name to the growing list of new firms in the solid propellant (SP) field (AW Sept. 30, p. 34). GAF HECF Inc., the new firm will specialize in production of perchlorate oxidizers for solid propellants, specifically ammonium perchlorate.

The expected growth in solid propellant was given as the reason for the formation of the jointly owned company. Another reason not mentioned, is the growing interest of solid propellant producers in particular perchlorate oxidizers, lithium perchlorate.

Until now, Hoodin had supplied ammonium perchlorate to missile field, even though the company is a prime producer of sodium perchlorate and potassium perchlorate. Foster, based in Alabama, which is one of the largest producers of lithium perchlorate, has had some interest and pilot plant production experience with both ammonium perchlorate and lithium perchlorate. In one issue, Foster had a contract to supply the oxidizer with lithium perchlorate for experimental purposes. By combining the two companies, production facilities and know-how at HECF Inc., both companies hope to widen a leading position as suppliers of ammonium perchlorate and lithium perchlorate.

At present American Potash & Chemical Corp. is the sole producer of potassium perchlorate in this country. Ammonium perchlorate which the company has been supplying to the missile program. Like Foster American Potash also has had some experience in the research and small scale production of lithium perchlorate and has a pilot plant available for manufacturing the oxidizer.

Should a large demand for lithium perchlorate develop, however, it will require more than a simple scaling up of present pilot plant facilities. In the past, both Foster and American Potash reportedly produced lithium perchlorate by a non-renewable method, by reacting lithium hydroxide with mercuric perchlorate and sodium perchlorate or potassium perchlorate. With an increased demand, however, production processes will probably favor both companies to make the oxidizer, by a

problem known in the late 1940s, much vehicle involved such things as weight/loss, other physical phenomena, but it was estimated that perhaps one of the greatest would be the "booster effect," a feeling of detachment from Earth and reaction varying in individuals from anxiety, loss of substance to exhilaration.

more direct method, such as electrolysis of lithium chloride.

Principal attention of lithium perchlorate is the solid propellant (SP) manufacturer is its percentage of available oxygen—68% by weight compared with 40% for potassium perchlorate and 25.7% for ammonium perchlorate. On a density basis, the figures are even more favorable. One cubic foot of lithium perchlorate contains 85.6 lb. of available oxygen, potassium perchlorate, 52.5 lb., and ammonium perchlorate, 38.2 lb.

In a composite solid propellant engine where the oxidizer accounts for 70 to 80% of total propellant weight, this can mean a significant increase in thrust efficiency and performance. The oxidizer and oxidizer can be made much smaller or for the same size, smaller solid propellant load and weight can be recovered.

Less significant is the slight gain in performance that can be gained from the composite burning of the fuel to these engines where a light excess of fuel is now required to heat the composite solid propellant together.

Too, there is the matter of lithium's lower density, which is comparable with potassium (70.3) and the ammonium oxide (16.00). This will save lower weight oxidizer products and, perhaps, extremely higher specific impulse.

Napier Rocket Engine Confirmed for P.1B

London—On consent announcement to the Napier Double Scorpion rocket engine as an optional additional powerplant on the English Electric P.1B confirms the prediction made by Aerospace Weekly (AW Sept. 30, p. 30).

Engine will enable the aircraft to operate either as a normal powerplant or a pure jet fighter according to operational requirements. Engine is fitted in a specially designed removable pod to the underside of the fuselage. Pod contains high test pyrolytic and is designed for safe handling and refueling either with the pod being in detached position for the engine will be down from the engine fuel lines.



JAPAN AIR LINES PICKS LINK

Now JAL, forms slender link in the world-girdling chain of great air lines buying Link simulators for their jet training needs.

Japan Air Lines has ordered an electronic simulator from Link Aviation, Inc., to train flight crews for its forthcoming fleet of DC-8 jet transports. By "flying" the simulator, JAL's experienced pilots will in effect be pre-flying the huge DC-8—long before the first jet liner joins JAL's Constellation Fleet from the U. S. to the Orient via Hawaii.

Using the simulator, Japan Air Lines crews will receive such complex and realistic training that the transition to the actual DC-8 will be smooth and natural.

As they have in the past, Link's electronic simulators train today's crews thoroughly, economically... make tomorrow's flights better and safer.

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Fuselage Hoops May Stop Crack Growth

Paradoxical—Technique for reducing crack propagation in pressurized cabins without an appreciable weight penalty has proved effective in full-scale cabin tests at the Boeing Aircraft Establishment.

Based on the use of narrow metal hoops gripping the fuselage skin at 10-in. pitch or intervals, the technique was developed by Dr. David Williams, deputy senior scientific officer at RAE, and a leader in the original Comet crash investigations.

Dr. Williams told *AVIATION WEEK* that the technique has implications which could revolutionize present thinking in pressure cabin design. He said the possibility of catastrophic failure with the hooped fuselage can be virtually ruled out.

Hooping the fuselage, he said, cuts the need for cracks and frequent crack inspection. The system calls for no changes in existing manufacturing configurations, strengths and stiffness.

Spaced 10 in. apart, the bands or hoops tend to act as a built-in local-restriction in skin stress on the order of 1/10th with the hard-line configuration, too. This is because the radial restraint exerted by the bands on the pressurized cabin does not fall off between the bands as it does with wide spacing of reinforcement. Due to the reduced stress, fatigue skin can be used for the same skin stress and the weight saved compensates for the weight of the bands, Williams said.

Crack Propagating Theory

Decreasing structural safety tests are chosen to demonstrate. Dr. Williams also admitted to *Aviation Week* that since these tests he has learned a theory which accounts for all the hitherto unsatisfactory features in the mechanism of crack propagation which have been reported by all workers in the field.

His investigations of a large number of metal details published have indicated that the results all conform to the theory of dimensional analysis applied to geometrically similar structures.

His theory means that the designer can now refer to a chart for exact predictions of crack propagation in any structure. His theory is still being circulated at the RAE and there has been no time for his report to be queried by the establishment's authority.

Significant cost-saving characteristics arising from the use of bands at

10-in. pitch is the fact that a fatigue crack stress concentration is not able to reach the critical value which the crack self-propagates at very high speeds.

According to Williams, fatigue crack reaches a critical length which depends solely on the size of the structure and the skin stress.

When it reaches this length the stress concentration is such that the crack self-propagates at one third the speed of sound in steel.

In a conventional cabin, 10-in. diameter, the critical length is 8 in. Up to this critical length, the crack de-

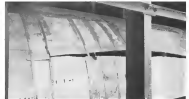
velops relatively slowly under repeated applications of the pressure load. As the crack develops, the load it sheds is accommodated by a stress concentration at the ends of the crack.

Williams asserts that, depending on the size of the cylinder, for one length of crack there is a unique stress which will cause it to self-propagate.

The results show:

(1) A 10-in. crack can go safely undetected for a whole year or so.

(2) A noticeable sign in the skin would not lead to structural failure as the bands are designed to accept the full circumferential cabin load.



CATASTROPHIC failure at Comet I jet transport test fuselage occurred only after metal bands and 20 in. of skin had been worn through. Test bands were 15 in. wide and 0.1 in. thick and were riveted to outside of Comet skin.



WATER spray method shows 5-in. crack has grown longer as Comet I pressure test. Hoops kept crack from spreading further.



CONVENTIONAL stringer and frame was not changed for hoop test. Cabin weight was not appreciably changed by hoops.



T-38 Undergoing Rocket Sled Tests

Advanced state of development of USAF's T-38 aerospace training plane is demonstrated in this view of prototype being hauled by Northrop Aircraft, Inc., at Hawthorne, Calif. Prototype has been shipped to Edwards AFB, Calif., for high speed rocket sled testing.

(7) A 25-in. crack extending across two panels together with fracture of the intervening band can be safely tolerated.

Coastal Cabin Used

The water tank tests on which Williams tested his theoretical analysis were carried out in a Coastal Mark I cabin which had already undergone extensive fatigue testing trials. The results have just been published in a report, C. O. No. 157.

The bands were 14 in. wide and 0.1 in. thick. These were tightly secured and riveted to the outside of the skin.

No other structural allowances were needed as the original strainers pitched at 5 in. and the frames at 28 in. followed current practice, while the skin on that particular Coastal Enclosure was already 18% thicker than that now used—22 S.W.G.—as against 19.5 W.G.

The degree of misalignment of the hoop structure to crack, propagates in a

veiled in the business of the following tests. It took 180 pressure cycles of 15 psi to crack a 5 in. saw cut across the remainder of the panel (the saw cut starting from one band), and 1,118 further pressurizations failed to propagate the crack under the bands to their outside edges. That number of seconds is considered representative to one year's service of 5,000 hr.

In another test, a full panel crack was further extended by 1 in. saw cuts into the adjacent panels and another 1,300 reversals and succeeded in extending the crack a further inch each way.

To demonstrate band failure, a full 10 in. crack was extended by sawing through a band. When such stresses were stopped and cyclic pressurization was reversed. When the band failed, the crack shot across to the next band which completely arrested the fast-running crack. Crack ran then 20 in. and it was not until a second band

was seen halfway through that catastrophic structural failure occurred.

Action of the straps in partly restraining the skin strap combination from expanding radially under pressure reduces the hoop stress in the skin. In his theoretical analysis Dr. Williams shows that the restraint not only depends on the stiffness of the restraining element itself but also on the ratio between the bands, where it constitutes a continuous, depends only on pitch.

At 30 in. pitch, restraint makes the tension bands fall to zero, and the skin shows at that point assumes the same value as it would on a totally unrestrained cylinder. For a 20 in. pitch, as it is commonly used for frames, the restraint midway between bands continues to half the value at the bands.

But when the pitch drops to 10 in. the restraint midway between bands then becomes equal to that at the bands themselves. This leads to a uniform reduction in skin stress along the full length so that the amount of materials normally in the skin can be distributed between the skin and the straps. The Coastal cabin was equivalent to reducing the weight of the skin by one third and saving it for the straps.

Conventional designers also are obliged to allow a degree of radial or circumferential expansion of the skin. But with conventional design, this restraint is largely lost with a minimum void between the frames, and no account is taken of the stress reduction arising from it. The design function of the frames is solely to stabilize the skin so that the fatigue can stand below loading.

Stranger Section Important

The importance of the loading role assumed by the straps in this construction was not appreciated at the time of the experiments, Dr. Williams admitted. The influence of the straps has never been emphasized in some tests completed by a manufacturer only a few days ago.

In their tests, which were in part to verify Williams' restraint theory and, incidentally, it was found that irrespective of pitch, the frames exerted a strain local action which extended no more than an inch or two beyond it.

Cause of the discrepancy, it was discovered, was the use of Z section strainers with flanges perpendicular to the side instead of the highest section and so the Coastal. Lack of bending stiffness of the Z strainer, explained Williams, was the cause of the underestimation.

The strainers "quickly twisted" under load because the quarter of sheet was offset on each section.

Once a crack has developed its critical length of about 8 in., the Farnborough tests tend to show, the moment



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880 Skin Tested

Crack propagation resistance in aluminum alloy skin of the Convair B-58 jet transport is tested with a hydraulic device that puts longitudinal stress on fatigue section. Growth rate of a crack subjected to the test stress is measured while loading is under stress. Sample, a section above the window near the wing, is pulled apart by hydraulic stress and loaded again by internal air and water pressure. Total longitudinal stress is 150,000 lb., which elongates the section about 2 in. during the test. Every other 4 in. are cut and longitudinal to 20 in. Convair reports the structure did not fail. Engineers found that prolonged cooling of joint area and release of pressure was necessary to obtain major crack growth in the 20 in. aluminum strip die. With air cuts of less than 4 in., cracks could not be lengthened appreciably, the firm reports.

of disaster for a conventional aircraft has ended.

At that point the crack will self-propagate and a rapidly running crack is not likely to be arrested by conventional frames. It could self-reach before and to end of the column skin and take only a few milliseconds.

According to Williams, the metallic fuselage frames adjacent to the cracked panel are not able to take the load shed by the panel, and catastrophic structural failure occurs. "The extremely short time interval for the crack to spread of loads little time for the high energy to be dissipated as to dissipate in the crack progress. Consequently, a totally rigid column remains exposed to most of the original pressurization load.

With stress at 10 in. patch, the whole mechanism leading to this type of failure is prevented. Williams explains. The crack is never able to run because the stress concentrations mutually associated with the crack are progressively reduced by the presence of the bands as the edges of the crack approach them. Consequently, when the crack reaches a length which would be critical in an unchorded fuselage, the stresses, due to the presence of the bands, are not sufficiently high to cause it to self-propagate.

Furthermore, should the crack in a stressed fuselage spread unduly, all the bands throughout the fuselage, or

staple failure would not occur in the bands, are fully able to accept the skin loads. At the same time the air would be forced to expand to a large number of small openings, especially in the gaps between adjacent strips. This fact means that the local damage caused by the air expanding and prevents development of large openings which could produce adverse fragmentation and tearing in the skin.

Due to photographs with instant analysis, actually, wind tunnel tests to establish the drag caused by strips have been allowed. But a small-scale preliminary model test of a nose section indicates a total drag of the order of 100 lb. Williams said that the drag is so slight that it would be imperceptible to the crew, if at all light touch.

Since British manufacturers have been experimenting in Britain with strips, Williams recalled. But at the moment, he said, the more conservative air designers to the action on patch antibiotic growths. This he indicated, was apparent in a recent conservative meeting of government and industry, structural experts. There is evidence of a continuing policy of building up the frames, during the frame patch itself, using the skin so that stresses are lowered and crack propagation rates dropped, together with a more rigid crack propagation resistance.

Dr. Williams was forthcoming about confirming such a policy. He told American West that he "represents the use of fuselage crack stoppers." The deliberate strengthening of frames as they can offer effective reinforcement as the skin puts the skin frame into considerable tension, he said. This condition he depicted as "reaction con-

ditions of one of the first principles of engineering construction.

In addition to the primary structural control in such fuselage skin, in the actual expansion loads, Williams concluded as his theoretical analysis that there are heavy secondary stresses due to

• Extensive strains for string connections.

• Resistance of the skin flange and skin to accommodate the same initial expansion as the outer flange.

He explained that a structural element of all these adverse and complex stress distributions was an entirely on designable aspect to act as a last line of defense in a crack stopping situation.

These objectives, he said, were quite apart from the weight handicap in which he was facing as a manufacturer. Williams expects an early philosophy the purpose that visual inspection combined with thicker skins or an adequate integrated against cracks developing. He said this led to allow the development of secondary cracks either on the skin or on the ground that could lead in 10 to 20 in. crack.

Flexible Tail Turret Designed for B-58

Convair B-58 is being equipped with a flexible nose tail turret mounting a General Electric M61 Vulcan rotating cannon. The 30 mm devalued weapons can fire 7,000 rounds per minute.

Design of the tail turret installation presented some problem for Convair. A bubble type turret would create too much turbulence and, therefore, too much drag in a supersonic aircraft like the B-58. A control turret would be



CONVIAIR B-58's flexible nose tail turret mounts Vulcan B-58 nose rotating cannon.

Bug hunting... before testing... safety factors... flight testing—none of these traditional reliability concepts is sufficient to insure maximum performance of missile guidance systems.

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V There is the fifth of a series of advertisements dealing with basic facts about alloy steels. Through much of the information in chemistry, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

When Should Alloy Steels Be Ordered to Hardenability?

What is hardenability and how does it differ in carbon and alloy steels?

Hardenability can be defined as the capacity of steel to develop a desired degree of hardness, usually measured in depth. It is produced by special heating and cooling. Carbon steel, except in small sections, will normally harden to a depth slightly below its surface, while alloy steel can, under certain conditions, harden uniformly through its entire cross-section.

Surface hardness obtainable after quenching is largely a function of the carbon content of the steel. Depth hardness, on the other hand, is the result of alloying elements and grain size, in addition to the carbon present in the steel.

In general, where hardenability is the prime consideration, it is not too important which alloy steel is used, just as long as there is sufficient carbon present to give the prescribed hardness, and enough alloying elements to quench out the section. We might mention here that it is not considered good practice to alloy a small section excessively, since too free a use of alloying elements adds little to the properties and can, in some instances, induce susceptibility to quenching cracks.

There are, of course, numerous cases where factors other than hardenability must be considered, such factors as low-temperature impact, heavy shock, creep-resistance, and the ability to resist temper brittleness. Through-hardening, therefore, is not always desirable. For example, shallow hardening is often necessary in shock applications, because a moderately soft core is essential.

Our metallurgists will gladly explain where it is advantageous to order alloy steels to hardenability, and where it is preferable to order by analysis. They will also give you any help you may require in connection with heat-treating and machining problems.

And when in need of steels, remember that Bethlehem manufactures the entire range of AISI standard alloy grades, as well as special-analysis steels and all carbon grades. We can meet your needs promptly.

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BETHLEHEM STEEL



Bell Readies XV-3 for Conversion

Bell Helicopter Corp. chief test pilot Fred Cohen leaves member two prototype XV-3 aircraft during ground flight program during which tests will be fitted in five days' increments and fully fitted in big rapid configuration. Tests were interrupted to do full scale wind tunnel checks of new two-blade rotor which replaces former three-blade rotor.

latter but it would present problems too, since it would require technicians to have it away from dual rotor into a separate rotor which it would cause maintenance loads interfering with control of the aircraft. Bell's view is a strengthened case, composed of prop-operated plates which allow V-3 to be used in its function with a minimum disturbance of rotor and with minimum power.

The thrust designed by the Emerson Electric Manufacturing Co., has undergone static and flight tests at Eglin AFB, Fla.

Britain Weighs Aid For Rotodyne Tests

London—Discussions now proceeding with the Ministry of Supply will decide whether the government is to extend its support of the Fairey Rotodyne in order flight development costs.

Original contract was for construction of two prototypes and included no provision for flight development. According to a spokesman for the contract company, the government intended to finance the contract after completion of early flight trials before constructing full in the flight development costs. The second prototype was in full advanced and should be flighted this year. Release of the first aircraft in flight trials has proved an attraction, the company states.

It is understood that the Ministry is considering giving, for some, but not the bulk, of flight development costs. The company would not comment on whether it would be able to

proceed with the project on this basis. But a Fairey spokesman indicated the government is undecided, as pointed out with the wind-tunnel interest shown in both rotors and not the case of the aircraft.

Lockheed Acquires Service Installation

Dulled, Calif.—Lockheed Aircraft Service, Inc., has acquired the aircraft repair and repair facilities of Caliber and Eastern Aviation, Inc., Los Angeles, and plans to begin operations this month.

The Dulled installation near Lockheed facilities already operating at Ontario, Calif., International Airport, New York International Airport and Hensley Airport. However, Lockheed Aircraft Service also maintains a full-scale maintenance program with the Japanese government as well as a special division at Porton, Calif.

Facilities include a hangar, two new docks, a workshop and office space totaling 101,000 sq. ft., and an additional 751,000 sq. ft. of shop and parking area. Hangar and new docks will accommodate six four-engine transport-type aircraft simultaneously. Service at the base shop includes engine building and overhaul, hydraulics, electrical, sheet metal, machine, structural, auto and upholstery.

The Dulled facility will serve all domestic and international airlines on the West Coast.

California Eastern Aviation, a subsidiary of Caliber Eastern Airlines, will retain its headquarters at Metropolitan Dulled International Airport.

Chemical Bombers' Fuel Use Estimated

A group of 30 chemical bombers would require 335,000 tons of bombs fuel a year to keep flying, provided they use the comparatively expensive high energy fuel with about 35% of the time, Donald Gibson of Avior D Little, Inc., estimates.

This amount alone would create an annual market for 150,000 tons of bombs fuel, which is equivalent to 45% of current U.S. production. Avior, California points out that this does not take into account the development and production use of solid and liquid boost rocket fuels.

Gibson made the estimate in a speech to the American Institute of Mining, Metallurgical and Petroleum Engineers in New York.



B-58 Mechemed Forging

H. & B. American Machine Co. modified 21 in. B-58 mechemed (from 1960) from 20 in. (Aug. 1961) (AV Feb 23, p. 4)



Nuclear Warhead Genie Arms F-101B for Air Defense



First flight photographs of the McDonnell Douglas F-101B show aircraft armed with the Douglas M81 Genie, unguided nuclear air-to-air missile. The Genie is carried externally in the nose position in the rotating door which allows missile weapons to be carried as usually. Genie missiles are mated into the air stream just prior to launching.

Deflector strips have been placed on the fuselage, between the engine air inlets and Genies to keep flow disturbances created by the missiles from interfering with engine operation at high speed. The nose of the Genie probably is lowered just before firing so that its flight path will be a downward arc. That would keep the Genie's exhaust gases from entering the aircraft's engines. The F-101B afterburner appears to be longer than those on the first of its type in its. This could increase maximum power available at high speed and produce lower temperatures on the aft fuselage.





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Highly Reliable MICRO for Electronic Computer

Here are six MICRO SWITCH Precision Switches, designed, produced and thoroughly tested for highly reliable performance in electronic computer consoles, aircraft instrument panels and other types of control panels. . . . The series "PS" illuminated pushbutton and the "AS" series of rotary selector switches typify the best in MICRO SWITCH design and the ultimate in MICRO SWITCH performance and reliability.



Eye Appeal and Positive "Feel" Within Minimum Panel Area.

These are the Essentials in Console Design for Today and Tomorrow

Here are two of the many different designs available in Lighted Pushbutton Switches

The "50" series switch, shown at left, is a two position, alternate-action switch. The two level visual indication allows extra flexibility in complex control panels. The position of the button—up or down—indicates the condition of the circuit. An independent indicator lamp is free to give additional information, or it can be wired to go "on" and "off" with the switch.

The "50" series switch, at right, is a unique magnetically held pushbutton. This extremely versatile switch contains anti-circuit switching, indicator light and d-c holding solenoid in one compact unit. When the button is pushed, the switch contacts are held actuated until electrically released. This permits one-by-one "baiting" operation with remote electrical release, allowing complete freedom of panel layout.

These switches are available with two, three or four-wire contact structures. All lamp and button options may be used. They are rated at 5 amps, 125-250 vac, 3 amps, 30 vac.

Request Data Sheet No. 333.



50PSB-72
with 50PAS Button



50PSB-72
with 50PAS Button

Switches have uses unlimited



SWITCH Precision Switches and Aircraft Instrument Panels

Smallest Rotary Selector Switch Assemblies Available . . . Provide up to 20 Switching Units.

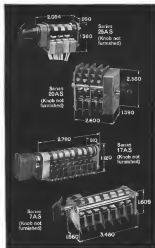
"25AS" series rotary selector switch assemblies are the smallest available with noncompromised sealed subminiature basic switching units. Assemblies are available with from two to eight zero sealed subminiature switches. Optional positive detent positions from 2 to 5. Rated 5 amps, 125-250 vac, 3 amps, 30 vac.

"30AS" series rotary selector switch assemblies are extremely versatile. Available with 4 to 30 "V3" type switching units. They are compact, sterility constructed, and highly reliable. Panel wiring and detent positions are optional. Rated 10 amps, 125-250 vac, 10 amps, 30 vac.

"17AS" series rotary selector switches are small compact assemblies available with up to ten zero subminiature basic switches. 45 degree angle detents are available in 2 to 5 positions. The use of these assemblies reduces instrument panel space. Rated 5 amps, 125-250 vac, 2 1/2 amps, 30 vac.

"7AS" series rotary selector switches are compact and sturdy assemblies of two to eight zero "V3" type switches, ideal for applications requiring multi-circuit control of 36 amp. circuits. Available in 2 to 5 detent positions. Rated 10 amps, 125-250 vac, 10 amps, 30 vac.

For complete details on these assemblies ask for Data Sheet 336.



The two-word name "MICRO SWITCH" is not a generic term. It is the name of a division of Minneapolis-Honeywell Regulator Company.

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6. Lighter and smaller than many cables now installed in aircraft.

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ARTIST'S drawing, left, shows nuclear-powered tanker. Powerplant at right would use sodium coolant, reactor would use solid fuel.



Mission Dictates Nuclear Engine Design

By Evert Clark

Washington—Almost every known type of solid propellant system can be adapted for nuclear power, but actual characteristics of engines from one type of aircraft to another will be strictly limited.

Operational problems arising chiefly from the radioactive hazard should be balanced out by gains in range and the advantages that result from the long, uncorrupted life of operation, freedom of mission and large payloads.

But the limitation that a powerplant developed for a bomber would not be the optimum design for a tanker, cargo, troop-carrying, or anti-submarine configuration might be an serious in detail change in operational limitations from the standpoint of rapid deployment of the jet.

Conceptual powerplants, particularly in recent years, usually have been developed first for a specific mission or each. Use then spans into other military aircraft and on into the commercial market.

Nevertheless, for aircraft where power requirements are high because speed and altitude requirements are high, as in bomber, a large payload in bombers, nuclear powerplants have a high potential.

Minister Dictates Design

Weight penalty imposed by sodium shielding and the weight of the jet after (half) when that's nuclear aircraft must have a high gross weight. Elimination of the conventional hot lead also means that gross weight remains constant.

Since power requirement and shielding weight and placement vary widely depending on mission, the mission requirement dictates reactor design and, therefore, aircraft design.

To show how mission determines design and to illustrate operational methods, Ernest B. Debes of General Electric Co.'s Aircraft Nuclear Propulsion Department has made a study of possible types of nuclear engines and aircraft and has developed the probable operational cycle of a tanker powered by sodium turboengines.

General Electric's Nuclear Propulsion Department is developing a direct cycle nuclear turbojet under contracts from Air Force and Atomic Energy Commission, and has successfully operated an experimental reactor in which a turbojet engine was run on hot applied in a reactor.

Basic difference between nuclear and chemical engines is in the method of supplying heat and the mechanical and civil vehicles that result. Heat can be provided directly by heating the propellant, or indirectly, by transferring heat from a primary fluid to the propellant fluid. Engines also may be of open or closed cycle, and combinations can be applied in turbojet, turboprop, turbopump, turbofan and rocket engines.

Possible Vehicles

Possible vehicles and missions outlined by Debes:

- **Bomber:** Nuclear weapons payload requirement would be moderate. But high speed and altitude requirements mean high power requirement, and, therefore, a heavy payload. Divided reactors should be used, part of it around the reactor and part protecting the crew. But reactor shielding would be cut to the minimum permitted by considerations of material design and structural advantages. Those rates higher than penetration standards might also be accepted. Performance gained by using a divided shield must be balanced against handling and servicing

problems, but training and turn around saving might be made automatic.

Lower gross weight could be obtained in a low altitude subsonic bomber, as by programming the mission so that much of it was conducted at low mission periods, permitting less weight in the crew shield.

• **Reconnaissance:** Payload would be moderate, as in the bomber, but probably would require a lower duty rate than modern bombers. Local checking of mission, etc., might be necessary. Servicing would be more important and time-consuming because of the more complex, reusable payload and would require a heavier reactor shield. Altitude and speed requirements would be similar to a bomber's, again requiring higher power.

• **Cargo or troop carrier:** Payload is large but moderate altitude and speed requirements permit designing the aircraft for maximum payload at minimum power. Cargo can take higher radiation doses than personnel, and some degree of shielding is light be possible.

Use of five turboengines in a unit should around the reactor is essential. Even then, crew dose rate must be kept to an identity lower than in a bomber because the aircraft would operate more frequently and for longer periods. Low external dose rates provide one significant advantage—servicing problems must be as great as in conventional aircraft.

• **Fuelers:** Requirements are similar to those of the cargo plane but, because fuel is the payload, a somewhat higher external dose rate is permissible. High rate after shutdown of the reactor would be sufficiently low to permit normal servicing operations, Debes said.

• **Anti-submarine warfare aircraft:** Low speed and altitude requirements permit low power. Payloads will be moder-



TEST INSTRUMENTS Bulova's rugged Telemeter Tester for jet and reciprocating engines reads MIL, T-1000, and other signals—accurate to 0.1% with engine on or off. Simple to operate and maintain, this field unit also serves in maintenance shops. Precision Bulova helps fulfill the dual purpose Telemeter—a dynamometer or calibrated torque source.



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POWERED COMPONENTS Bulova's 14 projects include units with 1000-watt electrical power and 1000-watt mechanical power, and other types specially matched any mechanical Bulova infra red, 1000-watt motor and electric and heat source units, many other units, including electronic and mechanical instruments...in volume and variety.

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for testing existing components.

Powerplant would not be operated on nuclear power, however, because radiation and aircraft problems would make it difficult to ship. For this reason, the powerplant would be shipped disassembled, with fuel elements in separate containers.

At the assembly area, fuel would be installed, complete powerplant would be assembled, nuclear power and charged with helium, and a full-power ground test made using a some remote test stand.

Powerplant would then be reduced to, but the reactor would have sufficient gas flow to permit handling with normal radiation precautions, even though the fuel would have a 1000-watt output during flight.

Installation Procedures

Special vehicles and procedures would be required for installing the powerplant in the aircraft because of large size and weight, nuclear hazard and the necessity for rapid control to avoid damage and plant automatic coupling property. Minor adjustments and some special connections could be made manually since the reactor has a low external shutdown time.

After installation, the cargo fuel load would be taken aboard and the powerplant brought up to normal and then to lower power. The automatic but actually slow operation could be done while cargo was being loaded.

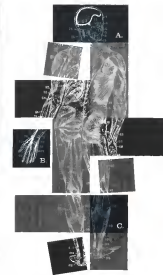
Once the reactor is on the power step, it could be taken to full power rapidly. Aircraft takes to the takeoff point and takes off after a short pre-flight survey. Pilot has the same single power control as in a conventional plane, but the flight engineer's job would be more complex.

Instead of over 100,000 to be used in the design, "Bulova said. Range would be limited only by the aircraft's radiation dose to the crew.

Naval officers of the fuel load to a point built was around the world and return flight could be accomplished without exceeding passenger radiation dose tolerances, since the aircraft flies out full and returns empty.

When the aircraft lands at its destination, powerplant could be completely shut down and reactor effluent removed before. This would be done by providing power to the helium compressor from an external source and an air supply to remove heat from the fuel tank. Power and air supplies could be attached manually or automatically at a special ground facility.

Immediately after shutdown, heat to be removed in an appreciable percentage of maximum power, but this depends upon grade. Debris and it probably will be necessary to conduct aircraft



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Outside view of J79 compressor (right) shows motor vanes adjustable for variable stators, one of several J79 lightweight features. Multiple exposure photo of rotor, above, shows point of blades.



GENERAL ELECTRIC'S LIGHTWEIGHT J79 SHOWS...

How An Old Principle Was Adapted To Meet New Aviation Demands

Above, you see one reason why General Electric has been able to answer aviation's need for higher thrust-to-weight ratio turbojets: the variable rotor compressor.

Based on an old—and extremely simple—principle, the variable rotor compressor matches rotor to engine speed by controlling the angle-of-attack of adjustable rotor stages—simple way to prevent compressor stall and provide the required airflow for efficient sub- and supersonic flight.

In General Electric's J79, the first jet compressor stage is variable. This arrangement, added to such lightweight features as a cooled turbine shaft,

staggered jet nozzle, and others, has produced a turbojet that is—

- Efficient at both sub- and supersonic speeds.
- Lightweight and durable.
- Easy to maintain.

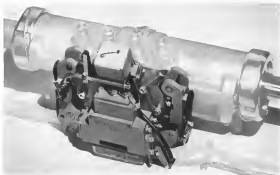
Proven in test and in flight, General Electric engines now power America's most advanced aircraft: USAF's Convair B-58, Lockheed F-104A, USN's Chance Vought Republic F-105 and Grumman F-11F-1B. And right now, an all-new General Electric jet engine—all members of G E's lightweight/high-thrust family—are exceeding performance expectations. General Electric Company, Cincinnati 25, Ohio 302



G-E LIGHTWEIGHT ENGINES PAY OFF IN SPEED. Powered by General Electric J79, Lockheed F-104A is world's fastest production fighter. Convair B-58 is world's fastest bomber.

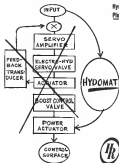
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"Hydomat" cuts 27 pounds off Standard Aircraft Control System

Hydraulic Research's System Eliminates 9 lbs. of Components Per Axis,
Plus 18-30 lbs. of Plumbing and Structure Without Sacrifice of Function



The Hydomat is a powered flight control servo system of the multi-feedback type designed for control of a tandem hydraulic cylinder. It not only accepts mechanical signals created by the pilot, as well as electrical control signals created by electronic amplifiers. Means are provided to precisely select the signal source to obtain the following modes of operation:

1. Manual: Mechanical signals operate the valve in the conventional power control manner.
2. Autopilot: Electrical signals operate the valve as a conventional electro-hydraulic servo valve.
3. Booster: Mechanical signals operate the valve as in the manual mode with superimposed electrical signals to provide damping for improved airframe stability.

For flight safety provisions is made for full mechanical override of the electrical signal.

Hydomat modifications are currently in use in military control systems also.

Write for complete performance data.

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control all the time the aircraft is on the ground unless there are extremely long time lags between flights.

After fuel is exhausted, aircraft could return empty, using much lower engine power, or alternate cargo could be loaded. Alternate cargo would change power requirements and might dictate a modification in shield design.

Normal or emergency maintenance or overhaul would be done at the maintenance base, using the same installation equipment to remove the powerplant. Airframe could be taken to a destination where station if necessary, and normal airframe and weapons system maintenance cycle follow.

Powerplant again requires attention several times the time of shutdown. Removal, fitting and transport duty should provide the power and air supply required. Powerplant also could be stored until after use is sufficiently low that no special provisions are required.

Disassembly

Once aircraft has reached a sufficiently low level, the helium system may be opened and all equipment outside the shield disassembled. With the shield design selected by DeLore, most of this could be done safely with proper procedures. Some operations might require extended tools or remote manipulators. Components that are radioactive would be handled in special maintenance areas.

Shield assembly could be transported to a fully equipped hot shop, disassembled, and shield broken to permit removal of core, fuel elements and components. Some reactor control and shield components could be reused.

Normal overhaul cycle would include replacing fuel elements. Fuel might be processed at auxiliary facility to reclaim the usable portion.

New and available components would be assembled separately, as would the complete power package. It is then stored in a suitable, in case of great power test and installation.

DeLore pointed out that it is thus, as one of the basic fusion-powerplant types, removal and modes of operation would cause changes in all of the others because of these close interrelationships.

Vertol's Commercial 44 Gets Type Certification

Vertol Aircraft Corp. last week received Civil Aeronautics Administration type certification for its Model 44 commercial helicopter. Production aircraft is certified at a gross weight of 14,315 lb., compared to 14,400 lb. for the Model 42 prototype. Emergency amphibious gear and automatic pilot equipment developed for the Vertol Model 44 is being tested by CMA.

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The revolutionary Type 40-101 PLEXICODER commutates signals from up to 90 transducers at 117.5 samples per second and converts those data into modulated pulses suitable for interfacing to magnetic tape recording. The PLEXICODER accepts single or double-ended, positive or negative, low-level inputs from strain gauges and thermocouples. Oscilloscopes (with inherent filtering characteristics) and no optical system replace rotating impedance assemblies and complex electronic circuitry. Operating modes can be changed easily with adapter plugs. Over-all system accuracy is 1%. Maintenance in the field is accomplished without return to the factory—service-free life is a nominal 1000 hours. The PLEXICODER weighs 45 lb., measures 25" high by 8 1/2" in diameter. Designed for flight test and aerospace applications, rockets, or manned aircraft—ideal for engine test stands, telemetry systems, and ground-based data handling systems. Call your nearest CEC sales and service office, or write for Bulletin 1599-34.



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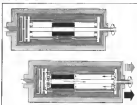
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AVIONICS



SMALL INTEGRATING ACCELEROMETER, with sensitivity of 10^{-5} Gs, consists of mass-film (left) in sketch at right inside rotating liquid-filled cylinder. Rotating fluid provides low-friction support for mass and its viscosity provides integration.

Accelerometer Has Sensitivity of 10^{-5} Gs

By Philip J. Klein

Good Neck, N. Y.—Integrating accelerometer for aerial navigation systems which is small, lightweight, extremely sensitive and accurate has been developed here by Sperry Gyroscope Co. Device now is in production for tactical vehicles which Sperry is building for undersea applications.

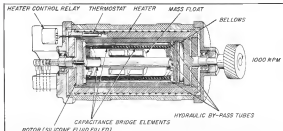
Threshold sensitivity of new accelerometer is quoted as "better than 10^{-5} Gs." This means for example that

the device can detect horizontal component of gravity produced by tilting its sensitive arm as little as two seconds of arc away from the true horizontal. This is equivalent to the angle produced by raising one end of a 14 in. long rigid pipe by one inch.

Accuracy of the device is quoted as "within hundredths of 1%" by W. G. Wing, head of Sperry's navigation component engineering department. Patents issued on accuracy as yet be accuracy of the 400 cps. resonant

signal pickup rather than by the acceleration-measuring mechanism, Wing says.

Because device is a linear accelerometer, it has far less mass coupling and smoothness cross than the widely used pendulum-type accelerometers, according to Wing. Integrating accelerometer weighs only 14 lb., and needs only a small 400 cps motor used to drive it. Single motor can be used to power two or more accelerometers, as Sperry does in our application, which



CUTAWAY shows details of Sperry integrating accelerometer including capacitive pickup which measures mass-film displacement (rotational velocity) hydraulic bypass ports and thermostatically controlled heater which maintains liquid at constant viscosity.

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BOMARC



Official U.S. Air Force Photo

It tracks down an enemy at 300 miles

Described as the most potent of all ground-to-air defense missiles, the Bomarc pitiless interceptor, designed by Boeing, stands poised for the destruction of any "enemy" bomber within a 200-300 mile range. Its booster rocket has the power to hurl it more than 60,000 feet straight

up; then, powered by two ramjet engines, it hurtles by electronic instinct to its target at up to 3 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.



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A report to engineers and accountants from Lockheed Missile Systems—where expanding missile programs assure more promising careers

LOCKHEED ENGINEERS DEVELOPING TRANSISTOR FLIGHT CONTROLS FOR POLARIS

Lockheed engineers are testing and developing transistor flight control systems for the Polaris ballistic missile program. Transistorization of missile control systems has been receiving top attention at Lockheed laboratories in Palo Alto and Sunnyvale. Advantages of its minor design over present systems include reductions in weight and space requirements. Flight control activities cover synthesis and analysis of systems, development or improvement of necessary hardware, bench and systems testing of complete control systems, specification of required flight test programs, and analysis of actual flight tests.

Division accountants and engineers are making every significant contribution that comes Lockheed leadership in missile development. Through their efforts, our Polaris has become the first and only solid fuel strategic ballistic missile program.

As greater emphasis is placed on missile role in U.S. defense, our missile projects will continue to grow. This means more career positions are open for qualified engineers and accountants—positions that offer unequalled opportunities for you to share ahead rapidly.

In addition to Flight Controls, openings are in: Electronics, Information Processing, Ground Support, Reliability/Producibility, as well as Guidance, Propulsion, Aerodynamics, Thermodynamics, Systems Integration, Human Engineering, and Structures.

Qualified engineers and accountants are asked to write M. W. Peterson, Research and Development Staff, Palo Alto 17, California.

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Gene Eklund, Flight Controls Development Manager, right, tells how results of a recent test with design engineer Carlos Acosta.

Airborne Modular Design Rotary Actuator

SERIES R12

100 in.-lb. max. op. capacity—25 v-d-c or 400 cycles/sec

DESCRIPTION:

1. Actuators are designed in most arrangements of 180, A, 90 and 270, 0-360° (360°—output is designed to meet requirements of 180, 0-360° v-d-c split load motor would normally rotate without duty motor with magnetic brake) 180°—output is designed to meet requirements of 180, 0-360° (180°—output is a single phase reversible intermittent duty motor with magnetic brake)
2. Actuator includes internal starting capacitor in order motor (for 180, 0-360°) and switches capability electronic through drive and one jamming mechanical stop
3. Operating strokes from 20° to 250° are available. An additional 20° of movement is provided. It is recommended position switches are used opening strokes of up to 70° either side of centerline position can be achieved.
4. Maximum operating life—up to 100,000 cycles. Ultimate stroke life—up to 100 (in 40°)
5. Weight—approx. 1.5 lb. for 180 Series, 1.5 lb. for 90 Series—includes mounting flange and output shaft drive. Weight for special mounting flanges and output shafts obtained previously in literature will be furnished on receipt of applicable specifications.
6. Electrical connector as shown in standard position, but may be located on either side of the special requirements.
7. Actuators can operate with dual winding power, inter-convertible providing electrical and thermal needed protection.

*Operating in order and gear unit motor
 *Operating in gear unit motor



MECH. OPTIONS OF TYPICAL RD/NA-12



Warning: motor when voltage is connected. It is connected to 0-360° (360°—output is designed to meet requirements of 180, 0-360°) and switches capability electronic through drive and one jamming mechanical stop



Area under curve represents maximum torque available with specified conditions. Performance beyond this line may be achieved by using special components.



Typical RD/NA-12 Module
 wt. 0.9-1.5 lb.

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CRITICAL DEPENDENCE on accelerometer accuracy, on viscosity of lubricant fluid forced Sperry to set up extremely elaborate facilities for measuring viscosity (left). That is shown under test (right) on special fixture where 90-angle is accurately controlled.

cycles who motor is not built into the accelerometer itself.

Three metal cylinders form the heart of the Sperry device. The smallest cylinder, called the "main-flux," is the acceleration sensing element. It is covered an aluminum fluid inside the next larger cylinder which in turn is supported by bearings within the outer cylinder or shell. Relative densities of the main-flux and aluminum fluid are such that the heavier would rise to the top of the liquid if it were not for the fact that the middle cylinder is driven at 1,000 rpm by an external motor.

With the middle cylinder rotating at moderately high speed, the aluminum fluid inside is caused to rotate and this produces hydrodynamic forces which enter and support the main-flux within the middle cylinder. Because the main-flux is supported by a rotating (near 90°) liquid, there is no static friction to be overcome and the slightest acceleration applied to the device along its longitudinal axis will produce a force which moves the main-flux along this axis.

Hydraulic Force Action

As the main-flux moves, it forces all some liquid from one end of the rotating cylinder through the clearance between the main-flux and cylinder into the opposite end in a sort of hydraulic piston action. The viscous restraint exerted by the aluminum fluid results in the main-flux moving at a velocity which is proportional to applied acceleration.

Total displacement of the main-flux therefore is a function of the amplitude of the applied acceleration and the length of time during which it is applied—in other words, the integral of

acceleration. Output signal from the accelerometer, picked off several around the rotating cylinder shell which is a measure of main-flux displacement, is thus proportional to the integral of acceleration, or velocity.

Error Compensation

In this device, in design, any error in the main-flux outer diameter or rotating cylinder inner diameter, or any layer along their length, would cause such inaccuracy even in acceleration output signal. To minimize this source of error, lubricant before holes are drilled axially through the length of the rotating cylinder shell and the center of the main-flux so that the bulk of liquid flows through these ports when the main-flux is displaced by applied acceleration.

Calibration (proportionality) factor between main-flux displacement and output voltage, depends also upon viscosity of the aluminum fluid. latter's viscosity changes about 1% per degree Fahrenheit change in temperature. Sperry uses a thermally-stabilized heater in the outer shell to maintain aluminum temperature within approximately 1°; but by means of a feedback construction technique, Sperry obtains additional viscosity compensation which results in only a 0.006% change in calibration for the use design variation.

In order to perform unique viscous measurements to the critical accuracy required for the integrating work contract, Sperry was forced to set up vacuumic measurement facilities which are equalled in the U.S. only by the National Bureau of Standards and two petroleum research laboratories.

Extreme accuracy and sensitivity of the new integrating accelerometer make it particularly well suited for use in inertial systems designed for guided missile or weapon systems where acceleration and acceleration changes are smaller than in ballistic missiles, wing add.

Intensive production volume is expected to extend requirements of Sperry's own aircraft systems and the surplus will be available to other aircraft system manufacturers.

Price price has not been set but the accelerometer is expected to sell at the several thousand dollar price range.



► **Turn Up in the Air**—Airborne version of Titus ground station equipment, suitable for installation in a library or airplane, to provide an airborne navigation reference, will be developed by Titus Bureau of Aeronautics.

► **New Intercept Radar**—Westinghouse Air Arm Division is developing long range airborne intercept radar under joint Air Force Navy sponsorship.

► **Berlin to Use Solid-State Converter**—British are ready to use solid-state step-down transformer, developed several years ago by Bell Telephone Laboratories, as new airborne equipment is needed for the Royal Navy. Because to its step-down technique follows as source into the British firm's and Radio Research Corporation, under extreme environmental conditions, Berlin also propose to use step-down

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BUSINESS FLYING

Private Pilots Learn IFR Quickly in Test

By Erwin L. Boffner

High degree of instrument flight proficiency can be readily given private pilots in primary training without adding appreciable to total time required for normal course, an experiment concluded recently at West Virginia University indicates.

Experiment was primarily aimed at providing students with sufficient instrument knowledge to enable them to estimate themselves should they encounter unexpected bad weather while

flying cross-country rather than make them limited instrument plots. How-

According to L. Z. Shtern, head of the University's Department of Agricultural Engineering:

Should such a requirement be mandated, it would have a major effect upon training curricula, and be beyond the scope of operators providing flight instruction.

In the report, it is interesting to note that the West Virginia University project was designed so that it could be used by a flight school operator with suitable equipped aircraft, the university states.

A Cessna 140A and a 170A equipped with complete instrument panels and

cubes were utilized. Attitude and directional gases were operated by externally mounted venturis. Aerobics Plexiglas coverings over the workbeds and side panels were combined with use of mechanical floor jacks to insulate blind flying conditions.

Financial Support

Although cost of the experiment was borne by Link Foundation, associated with Link Aviation, Inc.; manufacturer of flight simulators, it was carried out with the understanding that no test data therein would be utilized. Project was clearly observed by FAA and

Project	Type of financing	Design and construction cost	Years	Capital cost (£m)	New Plant and Machinery (£m)	General infrastructure (£m)	Total cost (£m)	Open Country	Use of Public	Total
1	Direct WFR	30	55	24	1,21	170	12,05	8,008	108	9,186
2	Direct WFR	3,000	2,50	21	1,12	1,000	3,900	3,900	130	6,130
	Indirect	1,500	2,50	21	1,12	1,000	3,900	3,900	130	6,130
	Total	1,500	2,50	21	1,12	1,000	3,900	3,900	130	6,130
3	Direct WFR	400	22	2,04	1,80	3,20	8,55	10,58	20	10,78
4	Direct WFR	3,000	2,54	2,00	1,80	3,20	8,55	10,58	20	10,78
	Indirect	1,500	2,54	2,00	1,80	3,20	8,55	10,58	20	10,78
	Total	1,500	2,54	2,00	1,80	3,20	8,55	10,58	20	10,78
5	Direct WFR	10	50	40	1,00	30	12,30	6,00	30	6,30
6	Direct WFR	10	50	40	1,00	30	12,30	6,00	30	6,30
	Total	10	50	40	1,00	30	12,30	6,00	30	6,30
7	Direct WFR	3,000	2,07	1,30	1,04	2,05	16,20	10,50	10	26,70
8	Direct WFR	3,000	2,07	1,30	1,04	2,05	16,20	10,50	10	26,70
	Total	3,000	2,07	1,30	1,04	2,05	16,20	10,50	10	26,70
9	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
10	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
11	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
12	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
13	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
14	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
15	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
16	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
17	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
18	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
19	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
20	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
21	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
22	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
23	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
24	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
25	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
26	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
27	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
28	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
29	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
30	Direct WFR	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68
	Total	3,000	2,06	1,30	1,03	2,04	16,19	10,49	10	26,68

TABLE DISTRIBUTION, given, flight phase, of experimental contact adjustment points

Results of the West Virginia University project are important in light of Civil Aeronautics Administration findings that a definite amount of instrument flight restrictions and demonstrated IFR proficiency be required of all classes of pilot certificates in the future including private pilots. Thought is to open a sharp decrease in number of fatalities, particularly among private pilots, due to instrument flies being caught inadvertently in adverse weather.

Weather Accident Factor

According to Civil Aeronautics Administration statistics for 1955, last data available, 49 fatal airplane accidents resulted from birds in the path.

Analysis further is that approximately 90% of the light aircraft currently being delivered are fitted with full complements of navigational instruments and radio, making them suitable for IFR operations, not just a small percentage of their owners have had formal air instruction in use of this equipment. Recent Piper sales indicated that although 54% of the TriPacer owners received an air study versus fully instrumented Super Custom model, only 11% were IFR qualified pilots (AW May 8, p. 232).

This would indicate that there is an enormous potential IFR workstation market now available for flight school operators.

Major Influence

West Virginia University experiment has had a major influence on the draft release and its content proposing a definite amount of instrument time for private as well as commercial institutions.

CAA representatives, with students checked by representatives of the former agency.

Two students, pulled from the university's curriculum and screened to assure that they had no previous flight training experience, ranged in age from 18 to 26. Students were required to complete the private pilot course during a single semester of 16 weeks and had to complete their complete and degree schedule, requiring flying on some days not entirely suited for it. These factors combined were responsible for some students requiring some dual instruction time that would have been normally necessary, the university feels.

Instrument training began with the first lesson and each of the dual instruction periods of private phase were divided equally between contact and IFR training. At the end of the primary flight program, two students were selected to take an additional 20 hr of IFR instruction, this advanced phase including instrument procedures and solo attempts.

Students were compared at the end of their first phases with flight students who had completed a conventional private pilot course; the two students taking additional instrument training were compared with applicants for instrument ratings who met requirements of CAR Part 23, paragraph 20.44, 20.127 and 20.128.

Flight instruction suggested in the experimental project held both contact and solo instruction but only one flight instructor also held an instrument rating.

Each was required five students. During the experiment there was an apparent difference in the instrument

proficiency of students assigned to either instructor.

University feels that this can be due to the fact that more descriptive procedures, instrument approaches and holding patterns were not included in the private, training phase, indicating that for this portion of contact/instrument training, students do not have to be a finished instrument pilot.

All 10 students passed the CAA's examination for private pilot certificate minimum time required of one student was 35 hr., 15 min., with one student passing after 44 hr. 3 min. instruction. Summary of time devoted to instrument flight instruction varied from 5 hr. 45 min. to a maximum of 2 hr. 59 min. Total time was counted from time throttle was opened until engine was stopped and included an average of 4 hr. 41 min. of flying time.

Comments from observers of the program agreed that the experimental-group students would have a much better chance of extracting themselves from adverse weather conditions than the average private pilot, reasons being far more exposure to instruments during contact flight and placing much more trust in their compass as non-visual flight. Observers commented that training in the private phase of the contact instrument project, did not equip students to make planned IFR flights.

CAA Examiners' Report

The CAA examiners who checked the two students who had taken additional instrument training reported that one student was fully up to the standard of instrument rating; the other student, with a few more hours of practice at altitude control and task

Progress in Propulsion at Marquardt



by
Roy E. Marquardt,
President

In all of the complex of modern weaponry no area affords more challenge than the field of supersonic and hypersonic propulsion. Here, where the stringent requirements for extreme weight, size and thrust are creating problems of critical consequence, Marquardt engineers and scientists are making continuous progress.

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Airway Traffic Control Procedures	130	3:15
Radio Orientation	5:30	5:35
Std. Inst. Approach Procedure and Missed Approach (VOR)	3:30	1:15
Std. Inst. Approach Procedure and Missed Approach (L/MF)	2:15	2:00
Holding Pattern	1:42	1:42
Approach Control	+102	1:21
Scattered CCA Advisory	230	1:48
Isolated Inst. Cross Country with Three Airport Approaches	4:15	4:15
Instrument Emergency Procedures	25	15
Total Time	20:04	20:28

FLIGHT SCHEDULE provided two students who took additional instrument training

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ing more precise "bite" at track intersections, would have met IFR standards.

No consideration was given to either combination of the students' lack of experience, several IFR grading standards being used. Examination revealed that there left the students faced in a better performance than many actual IFR applicants.

Observers felt that key to success of the experiment was incorporating instrument training into the beginning of flight training, providing a psychological incentive on the part of the student to accept the instruments as a part of the airplane rather than a separate adjunct. Checks indicated that students performed maneuvers, including slow flight, stalls, and maneuvers and turns for more proficiency on instruments than when using visual reference and actually performed during the maneuvers using these instruments. High-level of control flight technique was found due to the students' ability to read instruments and correct mistakes that would not have been noticed in "out of the cockpit" flying.

West Virginia University, Morgantown, has related results of the control-instrument flight training experiment in *Bulletin Series 15 No. 7-5*.

Civil Agencies to Use 278 Aircraft in Year

U. S. government civil agencies will operate 278 airplanes, including 36 new airplanes, in Fiscal 1959. Growing budget for the planes, ranging from multi-engine transports to helicopters and helicopters, will total \$9,153,091.

Civil Aeronautics Administration is largest fleet operator, with 112 airplanes, most under Civil & WMA Life Service of Department of Interior with 72 aircraft used in enforcing fish and game laws. Department of Agriculture will operate 42 aircraft, including eight new airplanes to be purchased. Bureau of Land Management Service will employ 27 planes, mostly in border patrol.

Civil Aeronautics Board will use a single aircraft to carry accident investigation parties.

Reds Push Research On Flap Wing Craft

Motor-powered and turbo-powered models of ornithopter aircraft designs are being seriously studied by Soviet Engineers of the Ministry of Defense (Voluntary Society for Cooperation with the Army, Air Force and Navy).

Foreign types are called "flap ornithopters," the latter "flap biplanes." Some 11 different versions of ornithopter

craft have been developed recently, one of the flying ornithopter designs carrying one man with live wings and power plant strapped to his back. Other variations incorporate carrying several people in streamlined fuselages with retractable landing gear.

Construction reports were made of its first world-of-flight to 100 ft. Aeronautics this year-until the Koshka flying wing glider exhibited several years ago during a Moscow air parade. Koshka's wings flapped as its various attached pneumatic systems to extend the glider's flight.

USAF Plans Sale Of 350 Aircraft

Some 350 surplus bombers, trainers and cargo planes will be disposed of by USAF through competitive and sealed bids in the next few months.

On Apr. 10 USAF will dispose of 251 planes through written bids. Available will be 11 North American B 25s, 32 North American T 62s, 12 Douglas B 26s, 18 Cessna C-46s, 27 North American T 28s and one Bell H 13G helicopter, the latter without engine.

Seaplane sale planned for May has been moved up to June 11. On disposal list are 18 T-62s, 10 T 28s, 10 C-46s, 30 North C-47s, 15 B 26s and 15 B 27s.

Price announcements had stated that B-17 Norons, B-24 Libers, B-26

tail B-21 and North American P-51s would be included in the latter offering, but there have been no further data on planes being taken by other government agencies or business, or price sales at other Air Force activities.

Planes are all located at various Air Force Bases, Barks, Davis-Van Horn, AF, Texas.

Details can be obtained by contacting Hugh Pollock at the storage centers.

Northern Aircraft To Build Amphibian

Alameda, Mass.-Northern Aircraft Co., Inc., of Alameda has acquired manufacturing rights for Republic Aviation Corp.'s amphibious Seabee.

Canopus, which was produced by Northern Aircraft Co., Inc., and will build an improved Seabee version, based on results of engineering and design studies carried out in past two years.

Seabee parts will be manufactured at Alameda. Plans and plans to expand facilities and will also receive. Civilian aircraft production. Northern has leased 55 Connecticut since company was founded two years ago.

Moved to support Seabee rights followed purchase of majority interest in Northern by J. K. Davies, Boston, Mass., chairman of the board. Roy L. Strong, corporate lawyer, will continue as president and general manager.



Italians Test Four-Seat Helicopter

Construction tests are being made by new four-place L. 51 helicopter which will employ considerable reinforced plastic construction in its production form to cut final purchase cost. Forward by 150 lb. by Lynching & 55 in diameter for main rotor of 40 mph at 7500 power, 504-hp rate of climb, endurance of three hours and hovering ceiling, in ground effect, at 9160 ft. Weight empty is 1321 lb., gross weight is 2382 lb. Two-blade main rotor has 53.8 in. diameter, overall length of helicopter with blade aligned with fuselage is 35 ft., height is 9 ft. 6 in. Rotor controls incorporate critical features of Sikorski helicopters, for which L. 51 has production license in Italy.



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Certification Given For Executive PV-2

Supplemental type certificate, for conversion of surplus Lockheed PV-2 Ventura patrol bomber to executive, has been granted Oakland Aerospace Co., Calif., which is completing test airplane designated C-205.

Conversion will consist of 250 hp, at 10,000 ft. at 575 power of its Pratt & Whitney R3300 engines and will have a top speed of more than 2,000 m.p.h., according to Oakland Aerospace President Edwin H. Gough. Gross weight is 12,000 lb. and useful load is 15,000 lb. Seating can be fitted for eight to 14 passengers; the number one Oakland Aerospace conversion has 11 seats. Price is less than \$200,000.

Modification program includes recontouring the fuselage to provide closer lines, installation of new flaps with "bat wings" deleted, modified, squared off wings and relocated ailerons, large popper spoilers, relocated exhaust collect rings with short stubs, picture windows across nose.

Oakland Aerospace has been developing the PV-2 conversion for two years at the International Airport. In the company's next year, it is planned approximately 100 executive aircraft conversions.

PRIVATE LINES

Kawan from Aeroflot, Wichita, Kan., has shipped six airplanes of its T-1 low-wing specialized airplane, which is now available with either 150 hp or 180 hp Lycoming engine. Agricultural Engineering Division of Department of Agriculture, Forest Service, Ore., recently took delivery of a T-1.

Two-engine four-place Cessna Super Airc is reported being exported to more than 30 countries, with Kawan trade officials saying progress being rapid due to lack of similar Soviet built type.

Ray Aviation Services Co., San Francisco International executive plane terminal operators, is handling buying of Japan Air Lines transports. Ray has been providing similar services for Qantas, BOMC and Shell.

Aviastar Aviation Service Division has put customized Aviatour GTP 70-17 gas turbine auxiliary power and RCA AV146 weather radar in use, used of Civil Aeronautics Administration Cessna 440s and in checking navigators and communication facilities.

New Guinness Gullstream turbo prop-powered executive transport will undergo initial flight test program at company's Stuart, Fla., air terminal facilities.

Site is used because of high percentage of favorable flying weather compared to New York area.

Soviet Aviation industry is lagging in development and production of new light and medium size 1,000 lb.-4,000 lb. gross weight categories. Russian paper Red Star reports.

Fourth Annual Safety and Efficiency Clinic for owners of Beech airplanes started May 2. Sessions in each division's area will be held when factory crews will be on hand to present.

from free maintenance inspection of their aircraft. Check will cover more than 100 major items. Last year 1,527 Beech planes were checked during the tour.

Midland Aero Group, Midland Air Terminal Inc., and Minnesota Aircraft Inc., World-Chamberlain Field, Minneapolis, are now Aero Design & Engineering Corp. distributors.

First flight test is scheduled soon for Moth, Copter pressure helicopters, which made first full-scale flight at Boeing Field, Seattle, Wash. later last year. Moth has two Continental engines delivering 160 m.p.h. each, installation of a single 100 m.p.h. power plant is planned in later model.



ELECTRIC-POWERED rotor blade test rig delivers constant horsepower to helicopter rotor.

Electric Test Rig Curbs Vibration

Bloomfield, Conn.—(Helicopter rotor blades up to 90 ft. in diameter can be tested on a new 1,300 hp. electrically operated rig being put into operation here by Kaman Aircraft Corp.

Each is the eighth rotor test device to go into use at Kaman Aircraft. Others include those powered by both reciprocating engines and gas turbines, and facilities for running, tie-down tests on completed helicopters.

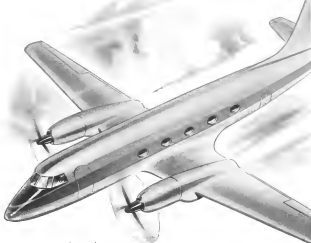
Company sees advantages of electrically powered test rig include:
• Elimination of torque variations and vibrations encountered in test rigs driven by reciprocating engines.
• High mounting of rotor, taking it better out of ground effect than is possible with electrically powered rig using

conventional aircraft engine to power a standard helicopter drive system.

• Ability of electric units to run fixed, not on variable speeds.

Another advantage, technicians said, is accurate measurement of power being applied to the rotor, achieved by measuring the current and voltage used in the electric motor. Motor also affords fine degree of rotor rpm control and can deliver constant horsepower to rotor at six rotor speed ranging from 300 to 400 rpm.

Electric motor drives 16-ft. vertical shaft on a ball rotor is mounted. Test operators are housed in a windowed console blockhouse equipped with windows with periscopes which provide unobstructed view.



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J. Nelson Lund, Jr., assistant director responsible for Military Industrial and Military Commercial Division, Alfred P. DuPont Laboratories Inc., Clifton, N. J.; John W. Rauer succeeds Mr. Lund as assistant, again from DuPont.

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